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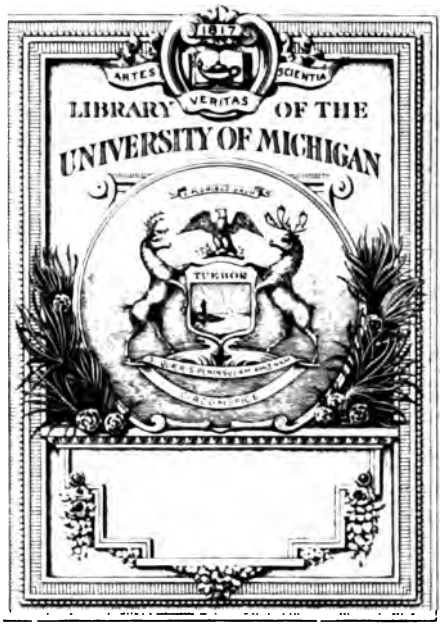
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OF THE

WISCONSIN ACADEMY OF SCIENCES,

ARTS, AND LETTERS.

Vols. 1-2

1870-2.

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1872.

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REPORT OF THE PRESIDENT.

His Excellency, CADWALLADER C. WASHBURN,

Governor of Wisconsin:

SIR: In compliance with the law, I have the honor to submit the following report of the "financial and other transactions" of the Wisconsin Academy of Sciences, Arts and Letters, for the year ending February 13th, 1872. And inasmuch as circumstances prevented the delivery of the report of the previous year in time for its transmission to the last Legislature, it has been deemed proper to embody herein such important facts as are necessary to complete the public record of the Academy from the date of its organization.

I.

MOTIVES IN WHICH THE ACADEMY ORIGINATED.

The Academy was organized on the 16th of February, 1870, by a Convention called for that purpose by the Governor and more than one hundred other prominent citizens of the State.

The general objects aimed at were these:

The material, intellectual and social advancement of the State;

The advancement of Science, Literature and the Arts.

1. On the part of the State, the reasons were as many as the number of the elements involved in both of these general objects. For while it was obvious that the advantageous geographical position of the State, the variety and vastness of its natural resources, and the character of its popula-

tion, both demanded and encouraged the employment of agencies calculated to rapidly advance it to a condition of material prosperity and power, it was no less demonstrable that true greatness could only be assured by the timely adoption and earnest use of measures looking to high intellectual and social development.

What then is the status of Wisconsin as a civilized State? was a question that demanded attention. And since the development of a people is illustrated and measured by its cultivation of Science and the application of it to the numberless uses of political, social and industrial life, as well as by its achievements in Literature and Art, it was a question that could be answered—a question, indeed, that *must* be answered, if new agencies for the advancement of the commonwealth were to be wisely planned and put into successful operation.

To the question, What has hitherto been done in the various departments of Science—that is, for Science and by means of it? the answers were these:

In Philosophy, which may be called the science of Science, and is the common, though unseen, source in which all the so-called sciences have their origin,—in Philosophy, distinctively considered, almost nothing, so far as had appeared to the public through the medium of any publication; unless, upon the one hand, by the application of established principles, to confirm past deductions, or, on the other, to supply facts for new generalizations. Indeed, we have learned of but a single important contribution to Philosophy made by a citizen of our State, and even that was a contribution to its literature rather than to Philosophy itself, to wit:

Upon the Present Stand-point of Philosophy. By Dr. K. S. Bayrhoffer, Ph. D., late of Green County, Wisconsin. Published by the *Philosophische Monatshefte* of Berlin, Germany, Vol. III., Nos. 4 and 5; Vol. IV., Nos. 4 and 5.

In Jurisprudence, barely so much as is represented by the organic and statute law of the Territory and State, and by the reports of judicial proceedings.

It was a just ground of pride and satisfaction that the decisions of the supreme court of Wisconsin had gained so high a reputation in the country at large, and that the jurists had won for themselves and the state so honorable a place in connection with American jurisprudence. But it was, nevertheless, a fact that hitherto no contribution had been made to the science and literature of this great department other than those contained in the catalogue of publications herewith presented, to wit:

Statutes of the Territory of Wisconsin. 1839 to 1848.

Revised Statutes of Wisconsin. 1849.

Revised Statutes of Wisconsin. 1858.

An Appendix to the Revised Statutes, from 1859 to 1867 inclusive, of the State of Wisconsin, in accordance with a Resolution of the Legislature. By D. A. Reed, Attorney-at-Law. Madison. 1868. 8vo. pp. 28.

The General and the Private and Local Laws since enacted and annually published.

A Digest of the Laws of Wisconsin from the year 1858 to the year 1868, both years inclusive; to which is added an Appendix, giving a List of all the Laws and Provisions of the Constitution passed upon by the Supreme Court. Compiled by E. A. Spencer, Counselor-at-law. Madison: Atwood & Rublee. 1868. One vol. 8vo. pp.

Laws of Wisconsin concerning the Organization and Government of Towns, and the Powers and duties of Town Officers and Boards of Supervisors, with numerous Practical Forms. By Elijah M. Hains. Chicago: Wm. B. Keene & Co. 1858. One vol. 8vo. pp.

Reports of the Supreme Court of the Territory of Wisconsin for 1842 and 1843. Reported by T. P. Burnett. Madison: Geo. Hyer. 1844. One vol. 8vo.

Reports of Cases Argued and Determined in the Supreme Court of the State of Wisconsin. By Daniel H. Chandler. Milwaukee: Sentinel Press. 1854. Four vols. 8vo. (1849 to 1851 inclusive.)

Reports of the Cases Argued and Determined in the Supreme Court of Wisconsin. With Tables of the Cases and Principle Matters. Vols. 1 to 11, by Hon. A. D. Smith; vols. 12 to 15, by P. L. Spooner, Esq.; vols. 16 to 24, by O. M. Conover, Esq. 1853 to 1870.

A Complete Digest of the Decisions of the Supreme Court of the State of Wisconsin, in Law and Equity, from its organization down to and including the Cases reported in vol. xiv of the Wisconsin Reports. By Wm. E. Sheffield, Counselor-at-Law. Chicago: E. B. Myers & Co. 1865. One vol. 8vo.

A Digest of Wisconsin Reports, from the Earliest Period to the year 1868; comprising all the Published Decisions of the Supreme Court of Wisconsin presented in Burnett's, Chandler's and twenty volumes of the Wisconsin Reports, with References to the Statutes. By James Simmons, Counselor-at-Law. Albany: William Gould & Son. 1868. One vol. 8vo.

Argument in the U. S. Supreme Court, in the matter of *ex-parte*, Wm. H. McCardle, Appellant. By Hon. Matt. H. Carpenter. 1868.

In the Science of Politics, so much had been done, and such contributions had been made, as appeared from the legislative journals, the executive messages, the proceedings of political conventions, the discussions and reports of discussions contained in the public journals, and the few political speeches which had been published in pamphlet form, namely:

Speech on the Fugitive Slave bill, delivered in the United States Senate, August 6, 1852, by Hon. Charles H. Durkee.

Speech on the Lecompton Constitution, delivered in the United States Senate, March 20, 1858, by Hon. Charles H. Durkee.

The Calhoun Rebellion; its basis. Speech of the Hon. J. R. Doolittle in the Unied States Senate, December 14, 1859.

State Rights. A speech delivered in Madison in 1860, by Hon. Abram D. Smith.

The State and the National Governments; their Mutual Political Relations; a speech delivered at Madison in 1860, by Hon. Tim. O. Howe.

Are we a Nation? By J. M. Bundy, Esq., Beloit, 1860. Second edition of same, with an Historical Letter by Hon. Tim. O. Howe. New York, 1869.

On approving certain acts of the President. Speech of Hon. Tim O. Howe in the United States Senate, August 2, 1861.

African Colozination. Speech of Hon. J. R. Doolittle in the United States Senate, April 11, 1862.

On the Conduct of the War. Letter of D. H. Waldo to Gov. Edward Salomon. Milwaukee, 1862.

On the Amendment to the Constitution. Speech of Hon. Tim O. Howe in the United States Senate, April 4, 1864.

On Reconstruction: being a Review of a Speech made by Hon. J. R. Doolittle at Madison in 1865. By John Y. Smith, Esq., Madison, 1865.

Reconstruction. Speech of Hon. J. R. Doolittle in the United States Senate, January 17, 1866.

On a Military Despotism. Speech of Hon. J. R. Doolittle in the United States Senate. 1866.

Reconstruction. Speech of Hon. H. E. Paine in the United States House of Representatives.

Reconstruction and Equal Suffrage. Speech of Hon. M. H. Carpenter, delivered in the Music Hall at Milwaukee, October 4, 1866. Milwaukee. 8vo.

The Legal Consequences of the Rebellion. Speech of O. H. Waldo, Esq., made at Racine in 1866.

Confiscation. Speech of Hon. C. A. Eldridge in House of Representatives, December 10, 1867.

Reconstruction. Speeches of Hon. Tim. O. Howe in the United States Senate, January 10, 1866, June 5, 1866, January 31, 1868.

On the impeachment of the President. Speech by Hon. Tim. O. Howe in the United States Senate.

On the Claims of Loyal Citizens living in the South during the Rebellion. Speech of Hon. Tim. O. Howe in the United States Senate, January 14 and 15, 1869.

State Rights and the Appellate jurisdiction of the Supreme Court of the United States: A Constitutional Argument. By a member of the Rock County Bar. Beloit: *Journal and Courier* print, 1869. 8vo.

The Mission and Future Policy of the United States. Address at the Dedication of Memorial Hall, Beloit College, July, 1869. By Hon. Matt. H. Carpenter.

Neutrality between Spain and Cuba. Speech of Hon. Matt. H. Carpenter in the United States Senate, December 15, 1869.

The Laws of Neutrality. Speech of the Hon. Tim. O. Howe in the United States Senate, February 2, 1870.

In Social Science, so much of Political Economy as was found in the executive messages, the legislative discussions and enactments, the annual reports of the State departments and industrial societies, of the boards of trade, and in the proceedings of conventions held in ihe interest of the various industries and of public improvements looking to our commercial supremacy; so much of Educational Science and Social Economy as was shown by our schools, libraries, charitable,

reformatory and penal institutions, by the statute law of the State, and by the documents, journals, and other publications mentioned below:

POLITICAL AND SOCIAL ECONOMY.

Depreciation of the Currency: a short essay on the Financial Condition and Prospects of the Country. By John Y. Smith, Esq. Madison. 8vo, pp. 14.

The Practical Development of the Resources of Science in relation to Agriculture and the Health and Habitations of the People. Dr. D. B. Reid, LL. D., F. R. S. E. 8vo, pp. 20. *See* also Trans. Wis. State Agr., vol. vi., 1860.

The Position, Value, and Duties of the Agriculturist in the Economy of Society. An address by J. H. Lathrop, LL. D. 16mo, pp. 34. 1851. *See* also Trans. Wis. St. Agr. Soc., vol. i., 1851.

The Farmer and the Manufacturer. Address by E. B. Ward, Esq., before State Agr. Soc. 8vo, pp. 20. 1868. *See* also Trans. Wis. State Agr. Soc., vol. viii., 1869.

The Growth of Monopoly in the Carrying Business. An address by Hon Matt. H. Carpenter, U. S. S. Milwaukee: Sentinel Print. 8vo, pp. 20. 1869. *See* also Trans. Wis. St. Ag. Soc., vol. viii., 1869.

On Banks and Railroad Bonds. By Hon. Moses M. Strong. Milwaukee Sentinel Print. 185-. 8vo, pp. 21.

On the Public Debt. Speech of Hon. Tim. O. Howe in the U. S. Senate, Feb. 12, 1862.

National Currency. Speech of Hon. Tim. O. Howe in the U. S. Senate, Jan. 24, 1870.

On the Purchase of Russian America. Speech of Hon. C. C. Washburn in the H. of R., Dec. 11, 1867.

On the Postal Telegraph. Speech of Hon. C. C. Washburn in the H. of R., Dec. 23, 1869.

The Iron Interests of America. Address of Hon. Tim. O. Howe before the American Iron Association, at Chicago, May 24, 1865.

Banks and Banking. 8vo, pp. 6.

Annual Reports of the State Treasurer of Wisconsin. 1848 to 1870.

Annual Reports of the State Agricultural Society. 1851 to 1870.

Annual Reports of the Milwaukee Chamber of Commerce. 1857 to 1870.

Report on the Improvement of Rock River; submitted by a Committee authorized by the Legislature. Adopted by Legislature of 1867. Janesville. 1867. 8vo.

Proceedings of the Wisconsin and Fox Rivers Improvement Convention, held at Prairie du Chien, November 10, 1868, and at Portage City, Octo-

ber 1869; with a Memorial to Congress. Prepared for publication under the direction of Lucius Fairchild, Governor of Wisconsin. Madison. Atwood & Culver. 1870. With maps. 8vo, pp. 88.

EDUCATION AND SOCIAL ECONOMY.

Universal Education necessary to the Stability of Republican Institutions. Address by Hon. Tim O. Howe before Wisconsin State Teachers' Association in 1865. Madison. 8vo, pp. 20.

The Claims of the Natural Sciences to Enlarged Consideration in our Systems of Education. Inaugural Address by Dr. E. S. Carr, M. D., Wisconsin State University. 1856.

University Progress: a Paper presented to the National Teachers' Association at Trenton, New Jersey, in 1869. Part I. The University of the Past. II. The University of the Present. III. The University of the Future. By John W. Hoyt, A. M., M. D., President Wisconsin Academy of Sciences, Arts and Letters. New York. D. Appleton & Co. 8vo, pp. 88.

Education in Europe and America: Being a Report to the Government of the United States in connection with the Paris Universal Exposition of 1867. By John W. Hoyt, United States Commissioner. Washington. Government Printing Office. 8vo, pp. 398.

Annual Reports of the State Superintendent of Public Instruction. 1848 to 1870.

Annual Reports of the Regents of the University of Wisconsin. 1849 to 1870.

Annual Reports of the State Board of Normal School Regents. 1857 to 1870.

Annual Reports of the Trustees of the State Institution for the Education of the Blind. 1850 to 1870.

Annual Reports of the Board of Trustees of the Wisconsin Institute for the Deaf and Dumb. 1852 to 1870.

Annual Reports of the Board of Management of the Soldiers' Orphans' Home, 1866 to 1870.

Annual Reports of the Board of Managers of the Wisconsin State Industrial School for Boys. 1859 to 1870.

Annual Reports of the State Prison Commissioners. 1852 to 1870.

Annual Reports of Board of Trustees of the State Hospital for the Insane, 1860 to 1870.

The annual publications of the colleges, seminaries, academies and local boards of education.

The published Proceedings of the Wisconsin State Teachers's Association. 1852 to 1870.

The Wisconsin Journal of Education. Published and edited successively by Geo. S. Dodge, Janesville; John G. McMynn, Racine; A. J. Craig and John B. Pradt, Madison, from 1856 to 1864; by Williams & Peck, Mineral Point, from 1866 to 1869.

The School Monthly. By Milwaukee Teachers' Association. 1869.

In Journalism, which might properly enough be considered under the head of Social Science, Wisconsin had reached a position which at once evidenced the general intelligence of her population and reflected credit upon her journalists; for the total number of newspapers and other periodicals was no less than 174,—of which 6 were monthly, 1 semi-monthly, 14 daily and weekly, and 153 weekly,—and for creditable appearance, editorial ability and extent of circulation, they compared faborably with the like publications of any state in the union.

It is also worthy of note that Wisconsin was one of, if not the, first of the states to form an editorial association (organized in 1857,) and that the same has had a career of uninterrupted prosperity and usefulness; holding annual meetings and publishing fourteen volumes of its proceedings.

A list of the newspapers and other periodical publications regularly issued at the date of January, 1870, will be found in the Legislative Manual for that year.

In the Natural Sciences more had been accomplished than at first appeared; but unhappily for our State, comparatively little of it could be credited to Wisconsin; and even this had been chiefly the work of a few private citizens devoted to scientific pursuits, such as Dr. I. A. Lapham, LL. D., and Dr. P. R. Hoy, M. D., who without other reward than the satisfaction of having done the public a great service, have continued their scientific labors without intermission even from early territorial times down to the present hour. Moreover, the work actually done, whether by citizens, the State, or the United States, had been almost wholly confined to geodetic, topographical, nautical and natural history surveys.

The State had four times in quick succession legally recognized the importance of a geological survey by the appointment of a geologist, or a commission of geologists, to perform that service—once in 1853, by the appointment of Edward Daniels; once in 1854, by the appointment of Jas. G. Percival to succed Mr. Daniels; again in 1857, by the reappointment of Mr. Daniels, upon the death of Dr. Percival; and yet again by the appointment of a Geological Commission consisting of James Hall of New York, and Edward Daniels and E. S. Carr of Wisconsin, in 1858. Nevertheless, except in the Lead Region, to which considerable special attention had been given by the sveral state geologists, but little more than general or preliminary work had been accomplished up to 1861, when the law instituting the survey was repealed.

In Pure Mathematics, and in Physics, including Astronomy, nothing of importance could be claimed by us. What had actually been accomplished, both by us and for us, in the departments of scientific investigation first above named, up to the date of which we are now speaking (1870), will appear on reference to the following quite complete catalogues of the books, journals and charts embracing the results of such labor:*

IN DESCRIPTIVE GEOGRAPHY, GEOLOGY, TYPOGRAPHY AND HYDROGRAPHY.

Report and Map of a visit to the Northwestern Indians in 1832. By Lieut. J. Allen and H. R. Schoolcraft. Executive Document. 1833-4. No. 323. Washington. 8vo.

Notes on Wisconsin Territory—Iowa Land District. By Albert M. Lea. Philadelphia. 1836. 12mo, pp. 53.

Observations on the Wisconsin Territory: Chiefly on that part called "The Wisconsin Land District," with a Map of the settled part of the Territory, as laid off by Counties by act of the Legislature of 1837. Philadelphia. 1838. 12mo, pp. 134.

* The author of this report has pleasure in stating that for the material of this and the subsequent bibliographical enumerations he is largely indebted to that efficient and conscientious public officer, Mr. Daniel S. Durrie, Librarian of the Wisconsin State Historical Society, and Member of the Academy, whose Bibliography of Wisconsin, being now quite complete, should somehow be published at an early day. For the perfection of his chartology, he acknowledges his indebtness to Dr. I. A. Lapham.

A Condensed Geography (and History) of the Western States, or the Mississippi Valley. Cincinnati. 1828. 2 vols. 8vo.

Boundary, Township and Sectional Surveys. Land Office Reports. 1833-41-44-48.

Map of Wisconsin Territory; Compiled from the Public Surveys. By Capt. T. J. Crane. Senate Document. No 140. 1st Session 26th Congres. 1838.

Reports of Surveys of the Mouths of Milwaukee, Root, Manitowoc, Sheboygan and Kewaunee Rivers. By J. M. Berrien. Senate Document. No. 175. 25th Congress, 2d Session. February, 1838. With Maps.

Report on the Improvement of Fox, Wisconsin and Rock Rivers. By Capt. T. J. Cram. Senate Document. No. 318. 26th Congress, 1st Session. March, 1840.

Report relative to Internal Improvements in Wisconsin. By Capt. T. J. Cram. Senate Document, No. 140, 26th Congress, 1st Session. January, 1840. With Map of the State.

Report on the Survey of the Boundary between Wisconsin and Michigan, with Maps. By Capt. T. J. Cram. Senate Document, No. 151, 26th Congress, 2d Session. February, 1841. Also Senate Document, No. 170, 27th Congress, 2d Session. March, 1842. See, also, Vinton on "the Northeast Boundary of Wisconsin," in Collections State Historical Society, Vol. 4, pp. 350, *et seq.*

Report of the Survey of Green Bay. By Capt. Wm. G. Williams. See Executive Document No. 170, 1st Session 29th Congress. 1846.

Report intended to Illustrate a Map of the Hydrographical Basin of the Upper Mississippi, made by I. N. Nicollet while in the employ of the Bureau of the Corps of Topographical Engineers, January 11, 1845. Washington. 1845. 8vo, pp. 170.

Elevations in Wisconsin. By I. A. Lapham. See Silliman's American Journal of Science, Vol. 46, (1844), pp. 258.

On the Public Land Surveys and the Latitude and Longitude of places in Wisconsin. By I. A. Lapham. See Collections State Historical Society of Wisconsin, Vol. 4, pp. 359 *et seq.*

Land Office Report. 1845. Maps of surveys of Mineral Lands adjacent to Lake Superior. By Gen. John Stockton. Report of 1845.

Report to the Secretary of War of Explorations and Surveys of the Mineral District of Lake Superior. By A. B. Gray. Washington. 1846. 8vo, pp. 23.

Survey of the Upper Mississippi River: Report of Gen. G. K. Warren, to the Sec. of War, of the Surveys of the Upper Mississippi and its Tributaries. Senate Doc., 2d Sess., 39th Congress, Lib. 15, 1867. 8vo, pp. 116. Also his Report for the year ending June 30, 1867, in Appendix "D," Ex, Doc. No. 1, House of Rep., 40th Congress, 2d Sess. 8vo, pp.

6. Also his Report for the year ending June 30, 1868, in Appendix G, Ex. Doc. 1, Part 2, House of Rep., 40th Congress, 3d Sess., Aug., 1868. 8vo, pp. 86.

Geographical and Topographical Description of Wisconsin, with brief Sketches of its History, Geology, etc. By I. A. Lapham. Milwaukee. 1844. 12mo, pp. 255. Also 2d Ed. greatly improved, with Map. Milwaukee. 1846. 8vo, pp. 208.

Report to the War Department of the Surveys, Commerce and Improvements of the Harbors of Wisconsin, Illinois, Michigan and Indiana. By Lieut. Col. Jas. D. Graham, U. S. A. Washington. 1856. 8vo, pp. 480.

Surveys of Sheboygan and Manitowoc Harbors (charts). By Lt. Col. J. D. Graham, U. S. A. 1856.

Chart of West End of Lake Superior, St. Louis River, etc. Lake Survey Report. 1861.

Map of the Territories of Michigan and Ouisconsin. By John Farmer. Detroit. 1836.

Map of the Surveyed Part of Wisconsin Territory. Compiled from pub. surveys. By S. Morrison, D. Dwelle and J. Hathaway, Jr. 1837.

Map of the Northern Part of Illinois and the Surveyed Portion of Wisconsin Territory. New York. 1836.

Sectional Map of Wisconsin. By I. A. Lapham. Milwaukee, 1846, 1847.

Map of Wisconsin, with Recent Surveys. By L. Chapman. Milwaukee. 1857. Subsequent Editions.

Map of the Copper Region of Lake Superior, embracing Michigan and Wisconsin. By J. Farmer. 1858.

Map of Wisconsin, prepared for Legislative Manual. By I. A. Lapham. 1865.

Map showing the Position of the Reef near Racine Harbor. By S. Farmer. 1867. The same, smaller. 1868.

Township Map of Wisconsin. By S. Farmer. 1867. The same, reduced. 1868.

COUNTY MAPS OF THE FOLLOWING COUNTIES.

Winnebago. By I. H. Osburn. 1855.

Milwaukee, Waukesha, Racine, Kenosha and part of Walworth. By S. Chapman.

Dane. By A. Menzes and A. Ligowski. 1858.

Milwaukee. By Louis Lipman. 1858.

Milwaukee. By H. F. Walling. 1858.

Waukesha. By H. F. Walling. 1859.

Dodge. By ——— ——— 1860.

Racine. By Redding and Watson. 1860.

Kenosha. H. F. Walling, 1861.
Green. By J. T. Dodge. 1861.
Sauk. By W. H. Canfield. 1861.
Columbia. By A. Legonski & C. Wasmund. 1861.
Sheboygan, By Randall & Palmer. 1862.
Jefferson. By H. Steeger.
Grant. By J. T. Dodge. 1863.
Grant. By Gray & Pettengill. 1868.
Milwaukee County and City. By Silas Chapman & S. Crampton. 1869.

IN PHYSICAL GEOGRAPHY.

On Supposed Tides on the Lakes, with Observations at Green Bay. By Maj. Henry Whiting. *See* Silliman's American Journal of Science, Vol. xx, pp. 205. 1831.

Indian Summers at Fort Winnebago, etc. *See* Silliman's Journal of Science, Vol. 30, 1836, pp. 8.

On the Tides of the North American Lakes, with Observations at Green Bay. By D. Ruggles. *See* Silliman's American Journal of Science, Vol. xlv., pp. 18, 1843.

Lake Superior: Its Physical Character, etc. By Lous Agassiz. Boston. 1850. 8vo, pp. 428.

The Fluctuations of the Water Level at Green Bay. By Col. Chas. Whittlesey. *See* Silliman's American Journal of Science, May No., 1859, pp. 8.

Some of the Supposed Causes of the Peculiar Climate of Wisconsin. Illustrated by a Chart of the State. By J. W. Hoyt. *See* Transactions Wisconsin State Agricultural Society, Vol. vi, 1860. Republished in pamphlet by the State.

Map of Wisconsin, with lines showing the Remarkable Effect of Lake Michigan in Elevating the Temperature of January and Depressing that of July. By I. A. Lapham. 1865. Republished in Transactions of Chicago Academy of Sciences, Vol. i, Plate x. 1865.

Remarks on the Climate of the Country bordering on the Great Lakes. By I. A. Lapham. *See* Transactions Chicago Academy of Sciences, Vol. i, p. 58. With Map. 1867.

Certain Physical Features of the Upper Mississippi River. By Gen. G. K. Warren. *See* Proceedings of American Association for the Advancement of Science. 1868.

The Mississippi Valley: Its Physical Geography; With Sketches of Topography, etc. By J. W. Foster. Chicago: S. C. Griggs & Co. 1869. 8vo.

Reports of Meterological Observations. *See* Army Meterological Register,

1826–1854. 4to and 8vo. Also Transactions Wisconsin State Agricultural Society, 1851 to 1859. Also Patent Office Reports, 1849 to 1861. Also Reports of Commissioners of Agriculture, 1863 to 1872.

Report on the Disastrous Effects of the Destruction of Forest Trees in the State of Wisconsin. By J. G. Knapp, I. A. Lapham and Hans Crocker, State Commissioners for that purpose. Madison. 1867, pp. 104.

IN GEOLOGY:

The Wisconsin and Missouri Lead Regions. By James T. Hodge. See American Journal of Science. Vol. 13, pp. 35 to 72. 8vo.

Report on Copper Mines of Montreal River. By James T. Hodge. 8vo. pp. 19.

Report of a Geological Reconnoissance made in 1835 from the seat of Government, by way of Green Bay and the Wisconsin Territory to the Couteau de Prairie. By Geo. W. Featherstonhaugh. Washington. 1836. 8vo, pp. 168.

Geology of the Region about Fort Winnebago. By D. Ruggles. See Silliman's American Journal of Science. Vol. 30, part 1. With Figures. 1836.

On the Mining Country in Wisconsin. By J. P. Sheldon. See Senate Documents, 25th Congress, 2d session. No. 411. May, 1838.

Report of a Geological Exploration of the Mineral Lands of Iowa, Wisconsin and Northern Illinois. With maps, plates, etc. By David Dale Owen, United States Geologist. Washington. 1840. 8vo. pp. 161. Includes Report of John Lock on Geological Magnetism and Antiquities of Lead Region of Wisconsin, pp. 116.

Fossils from Wisconsin, etc. By Alex. Winchell. See Silliman's American Journal of Science. Part 2. Vol. 37. pp. 226.

Observations on the Lead-bearing Limestone of Wisconsin, and Description of Fossils. By T. A. Conrad. See Proceedings Academy of Natural Sciences. Philadelphia. Vol. 1. 1843. pp. 329.

Report Relative to the Lead Mines. By Lieut. Col. G. Talcott. See House Documents, No. 152. 27th Congress, 3d session. February, 1843. Also another Report on same subject. House Documents, 28th Congress. pp. 28.

Report of the Ordnance Bureau on the Mineral Lands of the Upper Mississippi. Washington. 1844. 8vo, pp. 52.

Report to the Secretary of War relative to the Copper Mineral of Lake Superior. By Walter Cunningham. Washington. 1845. 8vo. pp. 8.

Report of the Secretary of War on the Condition and Government of the Mineral Lands on Lake Superior, with maps. By John Stockton. Washington. 1845. 8vo, pp. 22.

A Canoe Voyage up the Minnay Sotor; with an account of the Lead and Copper Depcsits of Wisconsin, etc. By G. W. Featherstonhaugh. London. 1847. 2 vols. Eighty maps and plates.

On the Lacustrine Deposits in the vicinity of the Great Lakes. By I. A. Lapham. See Silliman's Amer. Jour. of Science, 1847, pp. 90, with figures.

Report of a Geological Reconnoissance of the Chippewa Land District of Wisconsin; with a portion of the Kickapoo Country of Iowa and Minnesota. Numerous plates. By David Dale Owen. Washington. 1848. 8vo, pp.134.

Report on the Geology of Wisconsin. By J. G. Norwood. *See* Ex. Doc. No. 57, 1st Sess. 30th Congress. 1848. pp. 73–129. Washington. 8vo.

Report on the Geology of Wisconsin. By. J. G. Norwood. *See* Executive Doc. No. 57, 1st Sess. 30th Congress. 1848. pp. 73–129. Washington. 8vo.

The Geological Formations of Wisconsin. By I. A. Lapham. *See* Transactions of Wis. State Ag. Soc. Vol. 2. 1857. Page 122 *et seq.*

On the mineral Regions of Lake Superior. By F. C. Koch, Gottingen. 1851. 8vo.

Report of a Geological Survey of Wisconsin, Iowa and Minnesota and a portion of Nebraska, with 72 wood cuts, 27 steel plates and 18 maps. By David Dale Owen. Philadelphia. 1852. 4to., pp. 638.

On the Geology of the south-east portion of Wisconsin not heretofore surveyed. By I. A. Lapham. *See* Foster and Whitney's Report on the Geology of the Lake Superior Land District. Part 2d, p. 167 *et seq.* Washington. 1851.

Annual Report (first State Report) on the Geology of Wisconsin. By Edward Daniels, State Geologist. *See* Executive Messages and Documents of 1845. Doc. "H." 8vo, pp. 84.

First and Second Annual Reports of the Geological Survey of Wisconsin. By James G. Percival, State Geologist; (being for the years 1855 and 1856), with map. *See* Executive Messages and Documents of those years. pp. 101 and 111.

Report on the Iron Region of Dodge and Washington counties, with Maps. By Jas. G. Percival. Milwaukee. 1855. 8vo, pp. 9.

A Geological Map of Wisconsin. By I. A. Lapham. 1855.

Second Report of Edward Daniels on the Geology of Wisconsin; (being for the year 1857). *See* Executive Message and Documents. Doc. "P." 1857.

Preliminary Report on behalf of the State Commission of Wisconsin. By James Hall. Executive Message and Documents. 1858.

Report of Progress on behalf of the Geological Commission of Wisconsin. By James Hall. Executive Message and Documents. 1859.

Report of the Superintendent of Geological Survey of Wisconsin. By James Hall. January 1, 1861. Executive Message and Documents. 1861. 8vo, pp. 52. (Descriptive of Fossils.)

Report of the Geological Survey of Wisconsin. By James Hall, Superintendent; (covering Report of J. D. Whitney on "the Lead Region.") Vol. 1. Royal 8vo, pp. 466. With Plates and Maps. Albany. 1862.

The Penokee Iron Ridge, with Map. By I. A. Lapham. *See* Transactions Wisconsin State Agricultural Society. Vol. v. 1858-9. pp. 391 *et seq.*

Descriptions of New Species of Fossils from the Northwestern States. By I. H. McChessney. Chicago. 1859. Royal 8vo. pp. 154. With Plates.

Wisconsin Building Stones and Marbles. By Edward Daniels. *See* Transactions Wisconsin State Agricultural Society. Vol. vi. 1860. pp. 299 *et seq.*

On the Drift Cavities or Potash Kettles of Wisconsin. By Col. Chas. Whittlesey. *See* Proceedings American Association for Advancement of Science. Vol. 13, pp. 297. Springfield. 1860. Also, by same author, Origin of the Azoic Rocks of Wisconsin and Michigan. pp. 301.

Notice of New Potsdam Sandstone Fossils of Wisconsin and Missouri. By B. F. Sherward. *See* Transactions St. Louis Academy of Sciences, Vol. 2, 1862. pp. 101.

Fauna of the Potsdam Sandstone. By Jas. Hall. *See* Annual Report of Regents of University of New York, 1863. pp. 119. With Plates and numerous Figures of Wisconsin Fossils.

Iron Ridge Mines, Wisconsin. Milwaukee. 1863. 8vo, pp. 16.

Description of Fossils of the Niagara Group. By James Hall. *See* 20th Annual Report of Regents of University of New York. pp. 308. Plates and Figures of Wisconsin Fossils.

The Penokie Mineral Range, Wisconsin. By Chas. Whittlesey. *See* Proceedings of Boston Natural History Society, July 1863. pp. 10.

Relations of Niagra Group. Recent Limestone. By James Hall. *See* Annual Report of Regents University of New York. 8vo. pamphlet, printed in advance. pp. 48.

Report of the Bladder Rock Iron Property, Ashland county. By Chas. Whittlesey. 8vo, pp. 9. 1865.

Report on the Montreal River Copper Location, Ashland county. By Chas. Whittlesey. 1865. 8vo, pp. 5.

Report on the Marangoin Iron Property, Ashland county, with Map. By Chas. Whittlesey. 8vo, pp. 7. 1865.

Account of the Copper Lands of Sections 15, 16 and 21, Town 45 north Range 2 west, Ashland county. By Chas. Whittlesey. 8vo. pp. 6. 1865.

Fresh Water Glacial Drift of the Northwestern States. By Chas. Whittlesey. *See* Smithsonian Contributions. Vol. 15. 1866. pp. 32. Maps and Figures,

Mineral Regions of Lake Superior as known from their earliest discoveries to 1865. By Henry M. Rice. *See* Collections of Minnesota State Historical Society. 1867, pp. 8–12.

On the Mines of Wisconsin. By Edward Daniels. *See* Transactions of Wisconsin State Agricultural Society. 8vo.

Remarks on the Wisconsin Meteorite. By J. Lawrence Smith. *See* Silliman's American Journal of Sciences. Part. 2d. Vol. 47. March 1859, pp. 271.

On the Western Boulder Drift. By E. Andrews. *See* Silliman's American Journal of Sciences. Part 2. Vol. 48. 1769. pp. 172.

A new Geological Map of Wisconsin. Prepared from Original Observations, By I. A. Lapham. 1869. 15 miles to the inch.

IN BOTANY.

Catalogue of Plants found in the vicinity of Milwaukee. By I. A. Lapham. 1838. 12mo, pp. 23.

On the Plants of Wisconsin. By I. A. Lapham. *See* Proceed. Amer. Ass'n for Advancement of Science, Vol. 2, 1850, p. 19. Also published in Trans. of Wis. State Ag. Soc., Vol. 2, 1852, pp. 375 *et seq.*

Notes on the Woods of Wisconsin. By P. R. Hoy. *See* Trans. Wis. State Ag. Soc., Vol. 2, 1852, pp. 419 *et seq.*

The Grasses of Wisconsin and the adjacent States. By I. A. Lapham. *See* Trans. Wis. State Ag. Soc., Vol. 3, pp. 397 *et seq.*

The Forest Trees of Wisconsin. By I. A. Lapham. *See* Trans. Wis. State Ag. Soc., Vol. 4, pp. 195 *et seq.*

Additions to the Flora of Wisconsin. *See* Trans. Wis. State Ag. Soc., Vol. V., 1858, pp. 417; also Vol. VI., 1860, pp. 258.

Map of Wisconsin illustrating Distribution of Timber, etc. By J. W. Hoyt *See* Trans. Wis. State Ag. Soc., 1860.

IN ZOOLOGY.

Fauna of Wisconsin. By I. A. Lapham. *See* Trans. Wis. State Ag. Soc., Vol. 2, 1852, pp. 237 *et seq.*

Notes on the Ornithology of Wisconsin. By P. R. Hoy. *See* Transactions State Agricultural Society, Vol. 2, 1852. p. 341; also the same, with additions, in Proceedings Academy Natural Sciences, Philadelphia, Vol. 6, pp. 304, 381, 425, 1854.

Description of Minerals from Wisconsin. By P. R. Hoy. *See* Proceedings Academy Natural Sciences, Philadelphia, Vol. 6, p. 210, 1854.

Quadrupeds of Illinois, Wisconsin, etc. By Robert Kennicott. *See* Patent Office Reports, 1856. pp. 52.

The Sapsucker (*Picus varius* and *Picus pubescens*); with Illustrations. By Dr. P. R. Hoy. *See* Transactions Wisconsin State Agricultural Society, Vol. vi., 1860, pp. 243–249.

IN MEDICINE.

Transactions of the Wisconsin State Medical Society, Vols. I and II, 1842 to 1869.

Reports of Superintendent of the State Hospital for the Insane. *See* Reports of Board of Trustees, 1866 to 1870.

The Useful Arts had been cultivated with considerable success. Agriculture had advanced with steady pace, until the improved lands had an area of nearly five-and-a-half-million acres, and a total valuation of more than three hundred million dollars. Horticulture had won many honors in its struggles with the adversities of climate. The inventive genius of our citizens had made valuable contributions to the mechanic arts. Manufactures had reached an aggregate annual production of more than eighty million dollars, and in some important classes gained a supremacy in the western markets. State and county societies were in successful operation, guiding and stimulating the industry of the state in its various departments. Books and lesser documents had been regularly issued by authority of the legislature, while periodical and occasional publications, looking to the same end, had made good record of individual enterprise, and sown the seed of future harvests, as will appear from the following catalogue of industrial publications:

Notes on Wisconsin Territory—Iowa Land District. By Albert M. Lea. Philadelphia. 1836. 12mo, pp. 53.

Observations on the Wisconsin Territory; chiefly on the part called the "Wisconsin Land District," with a map of the settled part of the Territory, as laid off by counties, by act of the Legislature of 1837. Philadelphia. 1838. 12mo, pp. 134.

A condensed Geography (and History) of the Western States, or the Mississippi Valley. Cincinnati. 1828. 2 vols. 8vo.

Valley of the Mississippi: or the Emigrant's and Traveler's Guide to the West. With maps. By R. B. Philadelphia. 1835. 12mo, pp. 572.

The Western Transit to Ohio, Michigan, Illinois, and Wisconsin, and the Territories of Wisconsin and Iowa. By J. Calvin Smith. New York. 1840. 12mo, pp. 180. With maps.

Notes on the North-west or Valley of the Upper Mississippi. By J. A. Bradford. New York. 1846. Pp. 302.

The Wisconsin Farmer; a monthly Magazine devoted to Agriculture, Horticulture, Mechanic Arts and Rural Economy. 18 vols. 8vo. 1848 to 1866, inclusive. Managed from 1848 to 1856 by Mark Miller; 1856 by Powers & Skinner; 1857 to 1860, by Powers, Skinner & Hoyt, 1860 to 1866 by Hoyt & Campbell; 1866 by W. B. Davis. Changed January, 1867 to a weekly folio, with title of Western Farmer; 1867 to 1870, by Morrow Brothers.

Transactions of the Wisconsin State Agricultural Society. 8 vols., to wit: vol. 1, 1851; vol. 2, 1852; vol. 3, 1853; vol. 4, 1854–5–6–7; vol. 5, 1858–9; vol. 6, 1860; vol. 7, 1861–8; vol. 8, 1869, 8vo, pp. 500, each. Prepared by A. C. Ingham, D. J. Powers and J. W. Hoyt, successive Secretaries.

Industrial Progress and Condition of Counties. Trans. Wis. State Ag. Society, vol. vi., 1860

The Emigrants' Hand Book and Guide to Wisconsin. By Samuel Freeman. Milwaukee. 1851. 8vo, pp. 147.

Wisconsin: a paper prepared for the use of the State Immigration Agency. By J. H. Lathrop. Madison. 1852. 8vo, pp. 16.

Industrial Resources of Wisconsin. By John Gregory, C. E. Chicago. 1853. 12mo, pp. 329.

Wisconsin Gazeteer: containing the names, location and advantages of the counties, cities and towns, etc. By J. W. Hunt. Madison. 1853. 8vo, pp. 255.

Wisconsin Almanac and Annual Register. By J. W. Hunt. Milwaukee. 1856. 8vo, pp. 96. 1857. 8vo, pp. 119.

Hand Book of Wisconsin; or Guide to Travelers and Emigrants. By Silas Chapman.

Northern Wisconsin; its Capacities and Wants. By Albert G. Ellis. *See* Transactions Wisconsin State Agricultural Society, Vol. 2, 1852, pp. 326; also Historical Society Collections, Vol. 3, pp. 135.

Western Portraiture and Emigrants' Guide; a Description of Wisconsin, Illinois and Iowa; with remarks on Minnesota; with Map. By Daniel S. Curtis. New York. 1852. 12mo, pp. 180.

Wisconsin and its Resources; with Lake Superior, its Commerce and Navigation; Map. By Jas. S. Ritchie. Philadelphia. 1857. 12mo, pp. 312.

Wisconsin; its Natural Resources and Industrial Progress; with a Map showing the General Geology, Climatology and Distribution of Timber. By J. W. Hoyt. Reprinted from Transactions Wisconsin State Agricultural Society for 1860, by order of Legislature. Madison. 1862. 8vo, pp. 68.

The Great West; or the Garden of the World; its History, Wealth and Advantages. By Chas. W. Dana. Boston. 1861. 12mo, pp. 396.

Wisconsin; its Resources, Condition and Prospects. By A. F. Carman. *See* Hunt's Merchants' Magazine, Vol. 28, pp. 444–453.

Wisconsin and its Resources. By Josiah Bond. See Hunt's Merchants' Magazine. Vol. 10, p. 541.

Emigrants' Guide to the West. By C. F. J. Moller. Madison. 1865. 8vo, pp. 14. (In Danish.)

Statistics—History, Climate and Productions of Wisconsin. Published by order of the Legislature. 8vo., pp. 32, with maps.

Wisconsin and the International Exhibitions of 1862 and 1867. By J. W. Hoyt, State Commissioner. Madison. 1869. 8vo. pp. 100. Also published in Transactions Wisconsin State Agricultural Society. Vol. 8. 1861–8.

Reports of Wisconsin Fruit Growers' Association. Organized in 1853. First reports in pamphlet form; from 1859–1865 inclusive. In Transactions Wisconsin State Agricultural Society.

Reports of Wisconsin State Horticultural Society, 1865–1870. See Transactions Wisconsin State Agricultural Society.

Proceedings of the Wisconsin Sugar-cane Growers' Convention. Madison. W J. Park, State Printer. 1864. 8vo.

The Fine Arts had received some attention, but had made little impression upon the life and character of the people. The practice in Architecture, both in the construction of private dwellings and buildings for public use, gave here, as elsewhere in our country, painful proof of a prevailing ignorrance of the principles of the art. Painting had been favored with many votaries of considerable promise, but no effort had been made to bring them into any sort of relations of associated effort, and there was nowhere in the State, even the beginning of what could be called an Art Gallery. Sculpture had been attempted by but two of our citizens, so far as we are aware, both of whom, however, were artists of high promise, and one of whom—Miss Vinnie Ream, a native of Madison—had already commanded the attention and confidence of the National Government and won for her name a more than national distinction.

In Letters, the product of our labor, though interesting, and in some cases of very superior quality, did not aggregate much

in amount outside of History. Even in this important branch, although a history of the State had been published, and important researches were steadily progressing under the direction of Hon. Lyman C. Draper, the accomplished and indefatigable Corresponding Secretary of the State Historical Society, comparatively little had yet been accomplished beyond the collection of material—an important work, to which the Historical Society has devoted itself with so much zeal and with such signal success that its library and collections fairly entitle it to rank second among the historical societies of the United States. So that the facts of Wisconsin history then accessible to the student, in printed form, must be sought for in a great number of works, of which, however, the somewhat extended catalogue herewith presented is believed to be very nearly, if not quite complete:

IN LANGUAGE.

Manual Latin Grammar. By Wm. F. Allen, A. M., and Joseph H. Allen. Boston: Edwin Glinn & Co. 1868. 12mo. [Also contained in foregoing catalogue of Educational Works.]

A Latin Reader; with Copious Notes and Vocabulary. By same authors and publishers. [Also found in list of Educational Works.]

The First Six Books of the *Aeneid*. Translation and Notes by F. S. Searing, A. M., Professor of Ancient Languages, Milton College.

Phocylidis Poema Adminitorium. Recognovit Brevibusque Notis Instruxit. J. B. Feuling, Ph.D., A. O. S. S., Professor Philologiæ Compar in Un versitate Wisconsinensi. Editio Prima Americana. Andoveri: W. F. Draperi. 1869. 8vo.

HISTORY—ANTIQUITIES.

Description of Ancient Remains, Animal Mounds, and Embankments, principally in the counties of Grant, Iowa and Richland in Wisconsin Territory. By Stephen Taylor. *See* Silliman's Amer. Journ. of Science, xliv., 21–41.

Indian Mounds, etc. By Richard E. Taylor. *See* Silliman's Am. Jour., vol. xxx. Also Squier & Davis' Ancient Monuments, pp. 124 *et seq.*

Observations on the Aboriginal Monuments of the Mississippi Valley. By Edward G. Squier. New York. 1847. 8vo.

Ancient Monuments of the Mississippi Valley: comprising the result of Extensive Original Surveys by Edward G. Squier and E. H. Davis, with

numerous engravings. Vol. 1. Smithsonian Contributions. Washington. 1848. 4to.

Ancient Mounds or Tumuli in Crawford County, Wis. By Rev. Alfred Brunson. *See* Histor. Soc. Collec., Vol. 3, pp. 178.

The Antiquities of Wisconsin surveyed and described on behalf of the American Antiquarian Society, with drawings, maps, etc. By I. A. Lapham. Washington. 1855. 4to, pp. 95.

Traditions of De-coo-dah and Antiquarian Researches: comprising extensive explorations, surveys and excavations of the Earthen Remains of the Mound Builders of America. By William Pidgeon. New York. 1858. 8vo.

EARLY EXPLORATIONS AND TRAVELS.

Voyage et Découverte de quelques Pays et Nations de l'Amerique Septentrionale en 1673, par le Père Jacques Marquette. Paris. 1681. 12mo.

Description de la Louisiane nouvellement découverte á Sud-ouest de la Nouvelle France, avec le carte du Pays, les moeurs et la Manière de vivre des sauvages. By Louis Hennepin. Paris. 1683. 1688; Amsterdam. 1680. 12mo.

Nouveau Description d'un très grand Pays situé dans l'Amerique entre le nouveau Mexique et la mer Glaciale, depuis 1670 jusqu'au 1682; avec des reflexions sur les enterprises de M. Carvalier de la salle, et autres choses concernant la description de l'Amerique Septentrionale. Utrecht. 1687. Amsterdam. 1688. 1711. 1720. 12mo.

English edition of the above London. 1698. 12vo.

New Voyages to North America; containing an account of the several nations of this vast continent; their customs, commerce and navigation on the lakes; the attempts of the English and French to dispossess one another; and the various adventures between the French and the Iroquois confederates in England. Containing also a geographical description of Canada, etc.; to which is added a Dictionary of the Algonkine Language; with twenty three maps and cuts. Written in French by the Baron La Houton; done into English. London. 1703. 2 vols. vols. 8vo. La Haye. 1703. 2 vols. 12vo. La Haye. 1715. 2 vols. 12vo.

Relations of the Jesuits: Contenant ce qui s'est passé de plus remarkables dans les missions des pères de la campagne de Jesus dans La Monville France. Ouvrage publié sans les auspices du Gouvernment. 1611–1672. Quebec. 1858. 3 vols. 8vo.

Voyage dans le Canada, et son naufrage en revenant en France. Par le père Emanuel Crespel. Frankfort. 1742–1752. Amsterdam. 1757. 12vo. and 18vo. Republished in English at London. 1797. 12vo.

Quotations from, in Smith's History of Wisconsin. Vol. 1. pp. 339. (Crespel's visit to Green Bay in 1728.)

Historical Journal of the establishment of the French in Louisiana. By Bérard de La Harpe. See French's Historical Collections Louisiana. Vol. 3. Also Smith's History of Wisconsin, vol. 1, pp. 321. (Le Sueur's visit to Green Bay and voyage up the Mississippi in 1693 and 1700.)

Discovery and Exploration of the Mississippi Valley; with the original Narratives of Marquette, Alloues, Membré, Hennepin and Anastase Donay, with a fac simile of the newly discovered Map of Marquette. By John Gilman Shea, LL. D. New York. 1852, 1853. 8vo, pp. 268.

Histoire et Description Generale de la Nouvelle France, avec le Journal Historique d'un Voyage fait dans l'Amerique Septentrionale. P. Fr. X. de Charlevoix. Paris. 1744. 6 vols. 12mo. 1744. 3 vols. 4to.

The same translated, with notes by John Gilman Shea. New York. 1866-70. 4 vols. 8vo.

History of the Conspiracy of Pontiac, and the war of the North American Tribes against the English Colonies after the Conquest of Canada. By Francis Parkman, Jr. Boston. 1851. 8vo. New York. 1853. 8vo.

Diary of the Siege of Detroit in the War with Pontiac. Albany. 1860. 4to.

New York Colonial Documents, published by order of the Legislature. Albany. 1855-1858. 10 vols. 4to. (Early History of Green Bay, etc.)

History of Louisiana or the western part of Virginia and Carolina, with Descriptions of both sides of the Mississippi River. By Le Page du Pratz. London. 1763. 2 vols. 12mo.

Journal of a Voyage to North America, undertaken by an order of the French King; containing a Description of Canada, Address to the Dutchess of Lesdiguieres. By P. Fr. X. Charle-Voix. London. 1761, 1763. 2 vols. 8vo. *See* also French's Historical Collections of Louisiana. Vol. 3.

History of the War between the United States and the Sacs and Fox nations of Indians in the years 1827, 1831 and 1832. By John A. Wakefield, Jacksonville, Ills. 1834. 12mo, pp. 142.

Synopsis of the Indian Tribes o. North America. (See Trans. Amer. Antiquarian Soc. Vol. 2. By Albert Gallatin. Worcester. 1836-38.

Sketches of the West, or the Home of the Badgers; comprising an Early History of Wisconsin. Milwaukee. 1847-8. pp. 48.

History of Illinois; (containing an account of the Black Hawk War.) By Gov. Ford, Henry Brown, Ex-Gov. John Reynolds.

Various other works relating to the Black Hawk War, by the following authors: Orrin Clemens, Keokuk, 1866, 12mo; Samuel G. Drake, Boston, 1851, 8vo; Lieut. Gen. Winfield Scott, New York, 1864; Benj. Drake, Cincinnati, 1856 and '58, 12mo; Elbert H. Smith, New York, 1848, 8vo; J. B. Patterson, Cincinnati and Boston, 1833 and 1834 and 1845, 12mo.

Annals of the West: embracing the principal events which have occurred in the Western States and Territories. By Jas. R. Albach. Pittsburg. 1857. 8vo.

Historical and Scientific Sketches of Michigan (including information about Wisconsin), by Gen. Lewis Cass, H. R. Schoolcraft, John Beddler and others. Detroit. 1834. 12mo, pp. 215.

History of Michigan, etc. By J. H. Lanman. New York. 1839. 8vo, pp. 398.

Sketches of Iowa and Wisconsin. St. Louis. 1839. 12mo, pp. 103.

Report on Indian Affairs: comprising a Tour in 1820 to ascertain the State of the Indian Tribes. By Rev. Jed. Morse. New Haven. 1822. 8vo, pp. 496.

Communications relative to his Travels in the Northwestern Wilderness of Wisconsin. By Rev. Alfred Branson. Wis. Leg. Doc., Dec. 19, 1843; House of Rep., 1844, appendix, pp. 30.

History of Wisconsin from its first discovery to the present time. By Donald G. McLeod. Buffalo. 1846. 8vo, pp. 309.

Sketches of the West; or Home of the Badgers: comprising an early history of Wisconsin and familiar letters on the country. Milwaukee. 1847. 8vo, pp. 48.

Early Voyages up and down the Mississippi. By Cavalier, St. Cozme, Le Sueur, Gravier and Guiquas; with an Introduction and Notes by John Gilman Shea. Albany 1861. 4to, pp. 191.

The Discovery of the Great West. By Francis Parkman, jr. Boston. 1869. 8vo, pp. 425.

Historical Collections of Louisiana; embracing many rare and valuable Documents relating to the Natural, Civil and Political History of the State; compiled with Historical and Biographical Notes. Philadelphia and New York. 1846–1869. 6 vols. 8vo.

History of the Catholic Missions among the Indian Tribes of the United States. 1529–1854. By John Gilman Shea. New York. 1855. 12mo, pp. 514.

Travels through the Interior of North America in the year 1767 and 1768. By Jonathan Carver. Illustrated with copper plates, colored. London. 1778. 8vo, pp. 543. Many times re-published.

Voyage in a Six-oared Skiff to the Falls of Saint Anthony in 1817, with an an Introductory Note by Edward D. Mill. Philadelphia. 1860. 8vo, pp. 88.

Report of Congressional Committee on the Petition of Sundry Indians of the Stockbridge Nation, comprising their Title to certain Lands. House Report, February 24, 1820.

Narrative Journal of Travels from Detroit northwest to the sources of the Mississippi river in 1820. By Henry R. Schoolcraft. Albany. 1821

pp. 424. Map and Illustrations. Also a summary narrative of the same Expedition revised and completed in 1832. New York. 1834. pp. 308. Also an Edition under the direction of the United States, with Official Report and Scientific Papers. Philadelphia, 1855.

Narrative of an Expedition to the source of St. Peters' River, Lake Winnepeck, Lake of the Woods, performed in 1823, under the command of Maj. Stephen Long; compiled by Wm. H. Keating. Philadelphia. 1824. 2 vols. 8vo. Map and Plates. London. 1825.

Sketch of a Tour to the Lakes, of the Character and Customs of the Chippewa Indians and of incidents connected with the Treaty of Fond du Lac; with a Chippewa vocabulary. Baltimore. 1827. 8vo, pp. 493.

A Pilgrimage to Europe and America, tending to the Discovery of the Sources of the Mississippi, etc., with a Description of the whole course of the same, etc. By J. C. Bettrami. London. 1828. 2 vols. 8vo. With Maps and Engravings. New Orleans. 1824. 8vo, pp. 328.

Tour of the American Lakes and among Indians of the Northwest Territory in 1830. By Rev. Calvin Cotton. London. 1833. 2 vols. 12mo.

The Ramble in North America. 1832 and 1833. By Chas. Joseph Latrobe. New York. 1835. 2 vols. 12mo.

Dakotah; or Life and Legends of the Sioux around Fort Snelling. By Mrs. Mary Eastman. New York. 1849. 12mo, pp. 268.

History of the Ojibway Indians. Boston. 1851. 12mo.

Personal Recollections of a residence of thirty years among Indian Tribes on the American Frontier. By H. R. Schoolcraft. Philadelphia. 1851. 8vo, pp. 703.

On the Northwestern Indians. By Alex. Ramsay. *See* Pres't's Mess. and accomp. Doc., 1849–50, Pt. 3, pp. 1005.

History of the Valley of the Mississippi. By A. M. Hart. Cincinnati. 1853. 12mo.

Report of Commissioner on Indian Affairs on the removal of the Winnebagoes from Iowa and Wisconsin to their Lands in Minnesota. *See* House Doc. No. 510, 1st sess., 31st Congress, 1850.

Wau-bun: the Early Day in the North-West, with illustrations. By Mrs. J. H. Kinzies. New York. 1856. 8vo, pp. 498.

Our Whole Country: Historical and Descriptive. By John W. Barber. Cincinnati. 1861. 8vo, pp. 1496. (Wisconsin portion, pp. 1167 to 1210.)

History of Wisconsin in three parts, Historical, Documentary and Descriptive. By Gen. William R. Smith. under direction of the Legislature. Madison. 1854. 8vo. Vol. 1, pp. 432; vol. 3, part 2, pp. 443,

Historical Collections of the Great West. By Henry Hare. Cincinnati. 1853. 8vo, pp. 410.

Lights and Shades of Missionary Life; or nine years in the Region of Lake Superior. By Rev. J. H. Pitezel. Cincinnati. 1859. 12mo, pp. 431.

Various papers relative to the supposed identity of Rev. Eleazer Williams (for a time resident at Green Bay) and Louis Capet, Dauphin of France, to-wit: In Putnam's Magazine for 1853, 4 and '68, by Rev. J. H. Hanson and A. H. Vinton ; in New York *World* (September 19, 1867.)

Military History of Wisconsin; a Record of the Civil and Military Patriotism of the State in the War for the Union. By Edmund B. Quiner. Chicago. 1866. 8vo, pp. 1022. Steel Engravings.

Wisconsin in the War of the Rebellion; a History of all the Regiments and Batteries. By W. DeLoss Love. Chicago. 1866. 8vo, pp. 1136. Plates.

The Army of the Potomac. Behind the Scenes; a Diary of Unwritten History. By Alfred L. Castleman, M. D., Surgeon of the 5th Regiment Wisconsin Volunteers. Milwaukee 1863, '68, pp. 288.

Battle Fields and Camp Fires of the Thirty-Eighth Wisconsin Volunteers. By S. W. Pierce. Milwaukee. 1866. 12mo, pp. 254.

A Soldier of the Cumberland; Memoir of Mead Holmes, of the twenty-first Wisconsin Volunteers. Boston. 1864, 1864, 12mo, pp. 240.

Metomen, Springvale, Alto and Waupun in Fond du Lac Counties, Wis., during the late War. Brandon. 1867. 8vo, pp. 16.

Statement of the Military services rendered by him to the government since March 1861. By Gen. J. C. Starkweather. Prepared at the request of the War Department. Milwaukee. 8vo, pp. 14.

Opening of the Mississippi: or Two Year's Campaigning in the Southwest; a record of the campaign, sieges, actions and marches in which the Eighth Wisconsin Volunteers participated. By a non-commissioned officer. Madison. 1864. 8vo.

History of the Wisconsin State (and Territorial) Medical Society, from the date of its organization in 1842 to 1868. *See* Transactions of the Society. Vol. 2, pp. 102. Beloit. 1869.

BIOGRAPHY AND GENEALOGY.

Biographica, Genealogica Americana; an Alphabetical Index to American Genealogies and Pedigrees contained in State, County and Town Histories, Printed Genealogies and kindred works. By Daniel S. Durrie, Librarian of the Wisconsin State Historical Society. 8vo, pp. 296. 1868.

Steele Family; a Genealogical History of John and George Steele, settlers at Hartford, Conn., 1635–6, and their Descendants, with general information respecting the families of the name. By Daniel S. Durrie. Enlarged edition. Sup. royal 8vo, pp. x., 168. 1862.

Holt Genealogy; a Genealogical History of the Holt family in the United States; more particularly the descendants of Nicholas Holt, of New-

bury and Andover, Mass., 1634–1644, and of Wm. Holt, of New Haven, Conn. 8vo. By Daniel S. Durrie. 8vo, pp. 367. 1864.

Bibliography of Wisconsin. By Daniel S. Durrie. See Hist. Magazine for July, 1869.

Such is a pretty full record, so far as made public, of the labors which had been performed by and for Wisconsin in the Sciences, in the Arts, and in Letters up to the year 1870. If it shows that in the Practical Arts—in the rough work of civilization—we had achieved marvelous results for a State of but twenty-two years, it reveals, on the other hand, how little has been accomplished in those higher fields of human activity, the scientific, literary and æsthetic, whose cultivation, if more difficult and apparently less fruitful of immediate results, is nevertheless not only indispensable to them but also essential to those high intellectual achievements which exalt man as an individual and make of the otherwise half-civilized community an enlightened and refined commonwealth. And, in so far as this deficiency has been shown, to that same extent has it been demonstrated that the welfare of the State would be promoted by an efficient organization formed for the express purpose of supplying it.

2. On behalf of Science, Literature and the Arts, the reasons which influenced the founding of the Academy are briefly stated.

The sympathies and aspirations of a people should not be limited to objects which refer to the State. Every community is in duty bound to contribute something to the common stock of human knowledge. Nay, more; there is a sentiment higher than even philanthropy, namely, fealty to *truth* independent of all its relations. It can hardly be said, to-day, when the rule of might is not yet ended, that a state or nation is influential in proportion as it cherishes those higher sentiments and makes them the rule of its conduct. But it is certain that none can justly claim the respect of mankind from whose policy they are excluded.

In other words, a people become truly great, prosperous and powerful, and thus fulfil the ends of the State, in proportion to their loyalty to the best interests of the race.

It was in view of all the foregoing facts and considerations that so large a number of the leading citizens of the State united their efforts in the movement which resulted in the establishment of this Academy, and that, in the call issued by them for the convention at which the organization was effected, they used the following language:

"An institution of the kind in question would bring into more intimate relations many men, who, though already more or less engaged in original studies and investigations of various kinds, accomplish less than they would had they frequent association with each other, a common storehouse into which to bring their material collections, and some proper medium through which to publish the approved results of their scientific labors to the world.

"It would awaken a scientific spirit in all enquiring minds, and thus lead to a more fruitful intellectual activity among the people at large and to a wider diffusion of useful knowledge.

"Through a scientific and economical exploration of the State, to which it would early lead—and which it might with great advantage direct—as well as through the published results of independent investigations, conducted by its members, it would do much towards bringing the many natural advantages of our State to the notice of foreign populations, and especially to capitalists, both at home and abroad; thus promoting the more rapid and more economical development of our material resources.

"It would result in new and important applications of science to the practical arts, and thus advance the industry of the country.

"It would associate artists of every class, establish higher standards for the execution of works of art, and lead to the formation of an art museum.

"It would bring together men of letters and promote advancement in every department of language, literature and philosophy.

"It would also tend to promote the literary and æsthetic culture of the people, and by the quickening, invigorating, and elevating influence it would exert upon all our higher educational institutions, largely contribute to the social progress of the State, and the earlier insure to Wisconsin an advanced position among the most enlightened communities of the world.

"We further believe that the time has now come, when, with proper effort on the part of those who may be reasonably expected to aid in so important an enterprise, the foundations may be laid for an institution that shall be of great practical utility and a lasting honor to the State."

II.

Plan of the Academy.

In view of the general objects to be accomplished, the great value of associated effort, and the relation of harmony that exists between the several departments of knowledge, the Academy was broadly planned, so as to embrace every important interest of the State and every department of investigation looking to the advancement of knowledge.

Its objects more specificaly stated, are set forth in the terms of the Charter, as follows:

"Section 2. * * Among the specific objects of the Academy shall be embraced the following:

"1. Researches and investigations in the various departments of the material, metaphysical, ethical, ethnological and social sciences.

"2. A progressive and thorough scientific survey of the State, with a view to determine its mineral, agricultural and other resources.

"3. The advancement of the useful arts, through the applications of science, and by the encouragement of original invention.

"4. The encouragement of the fine arts, by means of honors and prizes awarded to artists for original works of superior merit.

"5. The formation of scientific, economical and and art museums.

"6. The encouragement of philological and historical researches, the collection and preservation of historic records, and the formation of a general library.

"7. The diffusion of knowledge by the publication of original contributions to science, literature and the arts."

The Departments named in the Constitution are these:

The Department of the Sciences.
The Department of the Arts.
The Department of Letters.

But with a view to subsequent development, the Constitution provides that, "any branch of these Departments may be constituted a Section; and any Section or group of Sections

may be expanded into a full Department whenever such expansion shall be deemed important."

By reason of modifications made under this provision, the present scheme of the Departments is as follows:

1st. The Department of Speculative Philosophy (not yet organized).

2d. The Department of the Social and Political Sciences—
Embracing:
- Jurisprudence.
- Political Science.
- Political Economy.
- Education.
- Public Health.
- Social Economy.

3d. The Department of the Natural Sciences—
Embracing:
- Mathematics.
- Physics.
- Natural History.
- Medicine.

4th. The Department of the Arts—
Embracing:
- The Useful Arts.
- The Fine Arts.

5th. The Department of Letters.
Embracing:
- Language.
- Literature.
- History.

Each department has its own officers, while all are under the direction of a General Council.

The membership embraces Honorary and Corresponding

Members, Founders, Patrons, Members for Life, and Annual Members.

Three meetings are held annually for the reading and discussion of papers.

The proceedings of the Academy at these meetings, including brief abstracts of the papers read, are published, as soon as practicable after the adjournment, in a neat octavo periodical called the BULLETIN.

III.

WHAT THE ACADEMY HAS DONE.

At the time of its organization, the attempt, in so new a State, to form an association whose active members must of necessity be capable of making either original researches and investigations or valuable contributions to the Arts, was thought by some cordial friends of the objects of the Academy to be a little premature. The results have shown, on the contrary, that the enterprise had been too long postponed. The presidents of our colleges as well as the professors connected therewith, distinguished scientists and members of the several professions, have heartily united in the inauguration of the enterprise and have since shown their deep interest in its welfare by giving to it not only their moral and pecuniary support, but also the fruits of their intellectual labor.

The present number of Life Members is, 12; of Annual Members, 55; of Corresponding Members, 29.

The report of the Treasurer, herewith submitted, shows the condition of the fiscal affairs of the Academy at the date of the late Annual Meeting.

[Copy.]

TREASURER'S REPORT.

WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS,
OFFICE OF THE TREASURER,
MADISON, Feb. 14, 1872.

HON. J. W. HOYT, *President of the Wisconsin Academy of Sciences, Arts, and Letters:*

SIR:—I have the honor to report the financial condition of the Academy as follows:

Total annual fees received from 44 members	$480 00
To fees from life members	807 25
	$1,287 25
Disbursed in payment of warrants, as per vouchers hertofore and herewith furnished	382 75
Leaving a balance in the treasury of	$904 50
Placed to credit of life members' permanent fund	$807 25
To credit of general fund	97 25
	$904 50

REPORT OF FINANCE COMMITTEE.

I have this day examined the foregoing report and account of the Treasurer, and compared the same with the vouchers and stub books, and find the same in all respects correct.

NELSON DEWEY,
Chairman Finance Committee.

MADISON, Feb. 14, 1872.

As the duties of all officers have been performed without compensation, and the expenses of members in making their investigations and attending the meetings have been defrayed by themselves, the only expenditures have been for incidental purposes and for the printing of the BULLETIN, of which five numbers have been issued.

The Museum of Natural History and the Useful Arts has made considerable growth, and must eventually come to be exceedingly valuable to the State for scientific uses, as well as interesting to the general public. By favor of the Governor and of the State Agricultural Society, it occupies the larger

one of the elegant apartments in the capitol so generously assigned to Agriculture some years ago.

There are many private collections in the State which would make great gain in usefulness could they be brought together at the capitol, and which, it is gratifying to be able to add, their proprietors, in some cases, purpose giving to, or depositing with, the Academy, so soon as suitable preparations are made for them.

Field work in Geology and the other branches of Natural History, being necessarily attended with considerable pecuniary outlay, it cannot be expected that very great progress will be made therein until the Academy is in a condition to relieve its members of at least a portion of such burden of expense. It already includes gentlemen fully competent to thorough work in each of the departments; and when this condition of pecuniary ability is reached there is reason to believe that, under a well devised system, embracing a judicious division of labor, a good deal may be done by it towards a scientific survey of the State, with comparatively little expense.

It is of much practical as well as scientific importance that further work of this kind should be done; for as yet no single county has been thoroughly examined in its relation to all the departments of natural history, and much the larger portion of the State, as already intimated, has not been favored with so much as a general reconnoissance.

The construction of railroads now in progress through the centre and northern portions, which are believed, upon evidence already furnished, to be rich in mineral and other resources, will facilitate the needed explorations and should prompt the state, as well as citizens who have an interest—and what citizen who has not?—in the development of that region, to extend to the Academy all reasonable encouragement in its endeavors to institute and carry on such investigations as properly come within the plan of its scientific labors.

The nature and extent of the work actually performed by members of the Academy, in the field, laboratory, and private study, since its oranization in 1870, will appear from the following titles of papers prepared for its meetings:

On the classification of the Sciences. By Rev. Albert O. Wright, M. A. New Lisbon.

On the importance of more attention to the Preservation and Culture of Forest Trees in Wisconsin. By Mr. P. Englemann, Secretary of the Natural History Society, Milwaukee.

The Coniferae of the Rocky Mountains, and their adaptation to the Soils and Climate of Wisconsin. By Hon. J. G. Knapp.

On the Origin of the Potsdam Sandstone. By Hon. John Murrish, State Commissioner for the Survey of the Lead Region.

On the Importance and Practicability of finding a Unit of Force in Physics that shall be of Universal Application. By Prof. John E. Davies, M. D., Wisconsin State University.

The Fauna of Lake Michigan off Racine. By P. R. Hoy, M. D., Vice President of the Academy, Racine.

On the Age of the Quartzite of Baraboo. By Dr. I. A. Lapham, LL.D., General Secretary of the Academy.

On the Formation of certain new Compounds of Manganese. By Prof. Jas. H. Eaton, of Beloit College.

The Metamorphic Rocks in the Town of Portland, Dodge county. By Rev. A. O. Wright, M. A.

The Metamorphic Rocks of Devil's Lake. By Rev. A. O. Wright, M. A.

Some Observations upon the Fauna of Mammoth Cave. By Mr. P. Engelmann, Milwaukee.

On the Nebular Hypothesis in Astronomy. By Dr. R. Z. Mason, LL.D., Appleton.

The Mineral Well at Waterloo, Wisconsin. By Rev. A. O. Wright, M. A.

On the Classification of Plants. By Dr. I. A. Lapham, LL.D., Milwaukee.

Metallic Veins and the Deposition of Minerals. By A. J. Finch, Esq.. Milwaukee.

On the Geology of the Region about Devil's Lake, Sauk county; being a Report of Observations made by request of the Academy. By Prof. Jas. H. Eaton, Beloit College.

On the Relations between Social and Moral Science. By Hon. Charles Caverno, M. A., Secretary of the Department of the Social and Political Sciences, Lake Mills.

The Mammalia of Wisconsin. By Dr. P. R. Hoy, M. D., Racine.

On the Climatic Relations of the Flora of Wisconsin. By Hon. J. G. Knapp, Madison.

Results of Recent Observations in the Lead Regions of Wisconsin. By Hon. John Murrish, Mazomanie.

On the Laws which Govern the Configuration of Comets. By John Y. Smith, Madison.

On the Kinetic Measure of Forces. By Prof. John E. Davies, M. D., State University.

On the Duty of the State to its Idiotic Children. By Prof. O. R. Smith, Milwaukee.

On the Place which the Indian Languages should hold in the Study of Ethnology. By Prof. John B. Feuling, Ph. D., Secretary of the Department of Letters, State University.

On the Clay Deposits and the Fossils found therein in the Region about Appleton. By Dr. R. Z. Mason, LL. D., Appleton.

On the Ancient Lakes of Wisconsin. By Hon. J. G. Knapp, Madison.

Suggestions as to a Basis for the Gradation of the Vertebrata. By Prof. T. C. Chamberlin, State Normal School, Whitewater.

Facts Relating to the Local Geology of the Whitewater Region. By Prof. T. C. Chamberlin.

On the Rocks and Mines of the Upper Wisconsin River. By Hon. J. G. Knapp, Madison.

The German Sunday. By Rt. Rev. Wm. E. Armitage, D. D., Vice President of the Department of the Social and Political Sciences.

The Relations of Capital and Labor. By Dr. A. L. Chapin, D. D., LL.D., Vice President for the Department of Letters.

Social Science and Woman Suffrage. By Hon. Charles Caverno, Secretary for the Department of the Social and Political Sciences.

The Common Jail System of the Country. By Hon. D. S. Hastings, Secretary of the State Board of Charities.

The Physical Basis of the Mineral Sources of Wisconsin. By Hon. John Murrish, late Commissioner for the Survey of the Lead Region.

Insects injurious to Agriculture—Aphides. By Dr. P. R. Hoy, Vice President for the Department of the Natural Sciences.

On the Age of the Quartzites, Schists and Conglomerates of Sauk county. By Roland Irving, M. A., M. E., Professor of Geology, etc., in the State University of Wisconsin.

Observations on some of the Coal Deposits of Colorado. By Dr. J. W. Hoyt, President of the Academy.

On the Potential Functions and their application in Physical Science. By Prof. John E. Davies, M. D., State University.

On a Modification of Grove's Battery for a special Purpose. By Prof. John E. Davies, M. D.

The Theory of Evolution illustrated by the Science of Language. By Dr.

John B. Feuling, Ph. D., Professor of Comparative Philology, in the University of Wisconsin.

The Rural Population of England, as classified in Domesday Book. By Wm. F. Allen, A. M., Professor of Ancient Languages and History in the University of Wisconsin.

Outline of a Plan for a National University. By Dr. J. W. Hoyt, President of the Academy.

While many of these papers were of such interest as to make their publication in full very desirable, the Council have limited their selection for this purpose to those herewith submitted, the important character of which must commend them to an intelligent public.

On behalf of the Academy, I have the honor to be, Sir,

Very respectfully,

Your obedient servant,

J. W. HOYT.

MADISON, March 10, 1872.

DEPARTMENT OF THE SOCIAL AND POLITICAL SCIENCES.

THE RELATIONS OF LABOR AND CAPITAL.

BY REV. A. L. CHAPIN, D. D., LL. D.,
President of Beloit College.

The problems respecting the relation of Labor and Capital which are now engaging the attention of all sorts of people in all parts of the civilized world, may be greatly simplified by a clear apprehension of a few elementary facts and principles. The presentation of these facts and principles is the object of this paper. I attempt nothing more than a brief digest of some matters familiar to all who are acquainted with the science of political economy. In this I follow mainly Mr. Mill's line of thought, and adopt often his own forms of expression, claiming no merit for the paper except for the putting of things together with a bearing.

We start with the simple fact that *all wealth is produced by the application of labor to natural objects.* In the case even of those objects which nature brings forth spontaneously in a form to gratify desire, some labor is necessary to find and appropriate them. In most cases some further labor is requisite to bring natural objects into a condition fit for use. Fig-leaves must be sewed together before they can serve for clothing. The fish and the deer, after being caught, must be divided, cleansed and cooked before they are fit for food. The dirty ore, taken from the bog or mountain, must pass through a succession of varied processes of labor before it takes the form of a knife, convenient for a thousand purposes. So it is with

everything which contributes to man's necessities, comfort or enjoyment. "All things are full of labor." In each we find a natural gift from God, with an added gift from man's labor. So long as there is found a desire of man ungratified, or an object of nature unappropriated or unexhausted of its capacity to gratify desire, there will be place for human labor to be applied to natural objects for the increase of wealth.

We advance a step and come upon another obvious fact. It is that in civilized society, *all the processes of industry require some accumulation of the products of former labor to begin with.* The blacksmith cannot begin his work without iron to work upon, and a forge and its fuel and hammer and anvil to work with. And, moreover, if he is to spend the day in his shop, the food which supports him must be provided beforehand. In other words, he must have materials, tools and sustenance. But these all come as the results of previous labor, his own or another's. So it is in every branch of civilized industry. To this necessary accumulation of the products of former labor the name CAPITAL is given. This is the radical idea of capital.

Now putting these two facts together, we have the universal fundamental principle that *the union of these two elements, labor and capital, is essential to the production and to the very existence of wealth.* Hence comes the obvious inference that the true relation of capital and labor is that of *partners—coadjutors* for a common end—*sharers* in a joint result. Each is indispensable to the other. Abstractly considered, they meet on an equality. Antagonism between them is ruinous to the interests of both. This view of the subject is fundamental to all sound political economy. It is so plain as to seem a truism which hardly needs a formal statement. Sound philosophy and common sense both sustain this view. Yet in practice it is very generally ignored, and in the sharp discussions of our times it seems almost lost sight of on both sides. Amid the din of the workshop and above the din of wordy contention this simple truth needs to be continually affirmed, elucidated

and reiterated. No labor reform movement can avail anything which does not start with the proposition that labor and capital are partners, not rivals, and write upon its banners, "What God hath joined together let not man put asunder."

For a better apprehension of the principle in all its bearings, let us linger a little on the questions—what is labor? what is capital? and what conditions most favor the harmonious and profitable union of these two forces of industry?

1. Labor is fitly defined to be "the voluntary effort of human beings to produce objects of desire." Since the human being is made up of body and mind, we must distinguish two kinds of labor, viz: physical labor, in which muscular exertion is the chief thing, and mental labor, which engages chiefly the faculties of the mind. I say *chief* and *chiefly* because in reality all human exertion combines some physical and some mental effort. The dullest laborer must think some about the work of his hands; and the profoundest thinker must task his muscles *some* to present to the world the products of his brain-work.

Recognizing this distinction, let us note what each kind of labor achieves. Mere physical labor only puts things in motion. The muscles of the body are made capable of contraction. This creates a pressure which when applied to a piece of matter, tends to put it in motion, or if it be already moving, to change or stop its motion. This is all that mere muscular exertion can do. But through this power of putting things into contact and relation with each other, man is able to command the hidden forces of nature to an unlimited extent. Man stirs the earth and drops a seed into it, then the forces of vegetation hid in the seed and in the soil multiply the seed a hundred fold. Man brings coal, places it in a furnace, sets fire to it, and at once a force of nature in the process of combustion turns the carbon into heat. He may add to the pile ore taken from the earth, and another force of nature by the action of heat makes the iron flow. Man's muscles grasp and wield the hammer only to enable nature's forces, gravitation

and density on the one hand, and tenacity and malleability on the other, to make the blow effective to shape the iron as he will. Man sets his poles and strings his wires and adjusts the components of his battery and arranges his machine so that by touching a key he can command that subtle force of nature, electricity, and make it the bearer of his thoughts to the ends of the earth. Yet in all this, physical labor only moves things; the forces of nature do the rest.

But how does the man know what things to move, what kind of motion to give and how to produce that motion so as to accomplish his purpose? Not every putting forth of muscular exertion is effective in producing desired results. Action must be suited to the nature of things and guided by methodical rule. Hence the constant necessity of *mental labor* to precede and attend the operations of all physical labor. The faculties of the human mind must be tasked in investigating the properties and laws of nature, in studying the philosophy of motion itself, to find the mechanical powers, in contriving in detail the means or instruments through which the force of nature may be made available, and various motions may be combined on philosophical principles for certain results, and in watching over the actual operations of both the human laborers and the natural agents in the complex combination of productive industry. It is plain on the bare statement of it that the mind-work of *discovery*, *invention* and *superintendence* is indispensable, an essential part of all productive labor, and that its importance and value, though often overlooked, cannot be overestimated. We say, therefore, of mental labor in this form, that it is *directly* concerned with all productive industry. We recognize, also, another kind of labor, chiefly mental, which is employed to develop and improve the physical, intellectual, moral and social condition of human beings themselves. The results of this kind of labor affect men individually and collectively, and determine very much their qualities as laborers and the circumstances

and associations in which they live and work. It is thus *indirectly* concerned with all departments of productive industry. Under this head may be set down the mother's nursing and training of her child, the teacher's efforts, the services of the physician, the lawyer, the minister of religion, the author, the editor and the greater part of the labor involved in the administration of government—all that is commonly called professional and official service.

This distinction of labor as directly or indirectly concerned in production is much more simple and better every way than the old distinction much insisted on by some writers on Political Economy and as strongly contested by others, of labor as *productive* or *unproductive.* The term unproductive can properly be applied to labor only when it is labor wasted through misdirection, as when a wag paid a man ten cents an hour to bail out the river, as its waters set up between two boats, or as a luckless inventor may spend years of brain-work and manual toil on a machine which has no practical use. Certainly we may not say of Morse's years of study and work in devising the elective telegraph, or of Webster's labor to bring under sentence of the law the murderers of White, or of Coan's preaching the gospel in the Sandwich Islands, it was *unproductive* labor.

Much exertion is put forth for mere recreation, as in hunting, boating, ball-playing, etc. If this really recruits mind and body, it puts the laborer in better condition for productive toil, and so indirectly aids it.

There are professions, such as those of the musician and the actor, in which labor is put forth only to furnish a passing entertainment—a moment's pleasure. Though after the entertainment is over, nothing is left which can be laid up and counted as wealth, yet is it for the time a real gratification, and the sweet memory of it will abide. The true end of labor is accomplished immediately. The satisfaction follows the effort instantaneously. The hearer of Nilsson has his *quid*

pro quo in the ecstasy of the hour. Why then is not this *productive* labor just as truly as if it had produced a ribbon for ornament, or a shoe for protection, or bread for food? Proper gratification of this kind cheers the spirits of men, and so increases their productive energy. If the recreation is, in kind or degree, exhausting, if the amusement is in its influence demoralizing, or if the taste be so fostered that amusement is made itself an end—then the economist and the moralist may fitly enter their joint protest against a waste and a wrong. But that labor which brings refreshing relief to wearied body and mind, or ministers a gratification to a pure and healthy taste, cannot be fitly called unproductive.

Still less properly can the term be applied to professional labor generally. It is a very common notion, which has been encouraged by some who would be esteemed philosophical writers on the subject, that the manual labor of the farmer, the carpenter, the cotton manufacturer, etc., is productive; but some are disposed to set down the mental labor of the doctor, the lawyer, the editor, the teacher, the legislator, etc., as unproductive. But the real difference is only that the labor of the latter class is directed in a general way to favor the essential conditions of effective labor universally. It is expended on the human beings individually and in their social state to fit them for labor, to protect them in their labor and to gratify and expand the wants which are to be satisfied by the fruits of labor. So long as physical health, intelligence, morality, security under good government and just laws, justly administered, and social refinement and good feeling are essential conditions of successful industry, all labor of the kind referred to must be set down as *indirectly* productive. Nor is labor in this form further removed from, or less essential to the ultimate result than is the labor of the miner in the ore-bed, with reference to the needle and the comfort of the coat made by its use. I have seen a pictorial sheet, the prominent object in which is a farmer standing in the centre, while around

him, in the margin, appear representatives of half a dozen different professions. The lawyer says, "I plead for all;" the merchant, "I trade for all;" the clergyman, "I pray for all;" the soldier, "I fight for all;" the railway manager, "I carry for all," and the physician, "I prescribe for all." But in letters of double size, the farmer is made to say with emphasis, "I *pay* for all."

Now I suppose this picture fitly represents the current popular notion on the subject. But according to the views just expressed, the notion is false. None can deny that agricultural labor lies at the foundation of human society, at the beginning of human industry, because it is busy producing the necessaries of life. For that very reason it is sustained, stimulated, and *paid by all.* It gives no more than it receives. Its interests are all identified with the growth of diversified society, organized, protected, enlightened, refined. In well ordered society each branch of honest industry is tributary to every other, and all are mutually dependent. For, to quote the words of holy writ, "the body is not one member but many, and the eye cannot say to the hand I have no need of thee, nor again the head to the feet, I have no need of you; nay much more those members of the body which seem to be more feeble are necessary and those members of the body which we think to be less honorable, upon these we bestow more abundant honor; and our uncomely parts have more abundant comeliness." There is necessity fixed in the nature of things that the greater part of men must be occupied with agricultural labor or other forms of manual labor. Let the intrinsic worthiness and dignity of all such labor be recognized and honored. But, at the same time, let it be understood that with this labor is closely interwoven all the busy brain-work of the minority who, though they seem to stand aloof, are efficient partners in both the toil and its results. The correction of the false and substitution of true views respecting labor itself, is the first step in every wise and sincere movement for labor reform.

2. Next we have to study Capital. It will serve for a general definition to say *Capital is that part of wealth which is actually employed in production.* Wealth is a broader term. Capital is a part of wealth. It is not synonymous with *money*, for money itself does not go into production. More specifically *Capital is the sum total of the products of former labor employed to provide shelter, protection, tools and materials for the processes of the production and to feed and otherwise to maintain the laborers during the process.* This threefold classification of capital should be particularly noticed. There are the *instruments* of production —as land, buildings, tools and machinery—the *materials* on which labor is expended, such as wheat, iron, cotton, leather, etc., and also *houses, food* and *clothing* for the safety and support of the laborers while engaged in productive operations. The items last named are usually provided for by the laborers themselves out of the wages paid them. *Wages* therefore represents this form of capital, whether paid in money or in rent and groceries and dry-goods.

Capital is not *money* but *things* in one or other of these forms. What a manufacturer wants is not money but a steam engine and gearing and spindles and looms and cotton. Laborers look at their money-wages only as means for procuring food and raiment and the protection of a home. Money is but the convenient instrument of exchange. The same money may go out of the bank in the morning, run around a busy circuit and get back in the afternoon. In its circuit, perhaps, it sent a machine to the shop and a load of wool to the mill and a load of potatoes to the laborer's home, but it comes back just what it went out; money is nothing else, though its value is represented threefold in as many forms of capital. So far as money has in itself real value it is a part of the products of former labor, saved and set apart for this specific service in the exchange of products. So it is capital in the form of an instrument which aids production. Banking capital is thus a portion of the wealth of a community appropriated to this ob-

ject. It renders a very important service. Yet the benefit it confers may all be resolved into the greater facility it furnishes for the transfer of values in the form of tools and machinery—materials and the means of sustenance—into one or other of which all capital must be brought in order to be made productive. The proper and legitimate business of a bank is to furnish just these facilities for the productive industry of the community in which it is located. When the banks of New York permit their funds to be absorbed in the gambling speculations of Wall street, they work mischief rather than benefit to productive industry. The wealth represented by their capital stock is withdrawn from production. It forms no part of *capital* in the true sense of the term. They are, for the time, so far, turned into nothing better than faro-banks, mere reservoirs of wealth, to be played with and shifted from hand to hand at the turning of cards. Wealth so absorbed can by no possibility come into union with labor. It is of the highest consequence to the clear understanding of our subject that the term *capital* be held strictly to its technical meaning, and that it be conceived of as existing mainly in the instruments, the materials, the wages, directly or indirectly provided for the employment of labor. Apprehending thus the nature of capital, I must content myself with the bare statement of a few fundamental propositions laid down and illustrated at length by Mr. Mill.

1. *Industry is limited by capital.* Every increase of capital may give additional employment to industry. Industry cannot go beyond the limit of capital; it may not, through lack of laborers, come up to it. This recognizes the mutual dependence of these two elements, labor and capital. It says, simply, that the most stalwart or skilled laborer can do nothing until he has tools and materials and something to live on while he is working, i. e., capital. If he has acquired these by former labor, then is he owner of the needed capital, and in a sense independent; if he has not these he must wait the will and

pleasure of some one who can come into partnership with him by finding these things for him to begin with.

2. *Capital is the result of saving.* To consume less than is produced is saving. Saving is simply laying up the difference between what one spends and what he earns—between wealth produced and wealth consumed. The amount saved and so added to capital may be increased by either consuming less or producing more, or both. There is no other source of capital.

3. Yet *capital though the result of saving is actually consumed in the very process of production.*

The wealth saved goes at once into implements, materials and provisions for the daily wants of laborers, and there is subjected to consumption, quick or gradual. It is withdrawn from all other possible uses. Investment for production and spending for enjoyment coincide in the first stages of their operations. Both begin with the destruction of a portion of wealth. But in the spending the first is the final stage. In the productive investment a second stage is reached, when an equivalent of what has been consumed is returned with increase. Thus capital is kept in existence from age to age, not by preservation, but by perpetual reproduction. The greater part of the present capital of England was produced within the last twelve-month. The growth of capital is like the growth of population. Every individual who is born dies, but in each year the number born exceeds the number who die. The population increases while the individuals pass away. So with capital; out of the productive consumption of one year comes a greater product available for the next.

4. *What supports and employs labor is the capital which sets it at work, not the demand for the completed product.* The *demand* for commodities determines the *directions* of labor, but not the amount of labor itself. That depends on the amount of the capital devoted to the sustenance and remuneration of labor.

One does good to laborers not by what he consumes on himself, but by what he does not so consume. This corrects the very common error that the lavish expenditure of the rich is a benefit to laborers. The distinction of wealth is in itself an injury or loss. The only qualification of this view needed is in the case of a class of rich persons who have no disposition themselves to turn their wealth into capital. Their lavish expenditure may bring their wealth into other hands, so that it may be used productively. The whole community, laborers most of all, are interested in the accumulation of wealth as capital. Saved and so employed, it is multiplying ever the sum of comforts in the world.

It is very obvious that the principles stated confirm the general view with which we started, that the true relation of labor and capital is that of partners. We are prepared now, in a few words, to define the conditions most favorable to their harmonious union. They meet most advantageously in the same person, i. e., when the laborer is owner of capital enough to employ his labor. This brings both the elements under the control of one and the same will, to be governed by one self-interest. All rivalry and antagonism is excluded, and according to the measure of his capital and his capacity, the man will multiply products.

But this adjustment cannot be made universal, because—

1. Such is the tendency of capital to increase that the man will soon find in his hands a surplus, to employ which he must either bring in another who has only labor to work under him, or lend it as capital to another independent worker, and so a distinction between capitalist and laborer is sure to begin.

2. But a greater difficulty comes from the fact that the capacities and tastes of men differ greatly. Some efficient laborers lack managing skill and tact in saving so as to keep and accumulate capital independently. Others peculiarly endowed in these respects lack physical strength for labor. To some,

manual labor is irksome, and they will seek exemption from it as soon as their increase of capital enables them to do so. Others find the care of managing business no less distasteful and so put their accumulating capital into other hands. Then,

3. Many forms of production, most essential to a state of highest civilization, must be carried on in large establishments which shall combine great capital and great numbers and divers grades of laborers. The most economical division of labor can be secured only through such establishments.

Hence there is a strong tendency to a separation of the two elements, so that the capital will be the chief concern with some and the labor with others. This disturbs the abstract equality and mutual dependence just spoken of. Perhaps with respect to actual increase, capital alone is most helpless. But in the meeting of persons to enter into contract, the capitalist has the advantage because *he can live* on his capital without labor, but the laborer cannot live except he earns his necessary food by working with somebody's capital. Under the sway of short-sighted self-interest, therefore, capitalists are inclined to use this advantage to domineer and oppress laborers. I say short-sighted self-interest, for in the long run and in the broad view, such oppression reacts upon the oppressors. When laborers are held down to starvation wages, capital must be heavily taxed for the support of paupers, and in time there must come an insurrection which will make capital insecure. On the other hand, the consciousness of dependence tends to make laborers sensitive to the least real wrong and suspicious of wrong where none exists. Against their own true interests on both sides the parties are thus led into a partial antagonism. The fact of these tendencies must be recognized. They are not so strong in our country as in England. Yet enough is apparent here to awaken thoughtful consideration. The problem is to guard the rights of both parties so that they shall be bound by their natural common interest in harmonious union with each other.

It is a hopeful sign that the minds of philosophers and philanthropists and practical working men and capitalists are just now intently engaged upon this problem. The surest way to reach the true solution of the problem is to enlighten the people generally respecting the elementary principles involved. By these both rights and interests are to be defined, and when they are distinctly apprehended, both parties will be drawn by natural affinity into harmonious union.

We may deduce from the principles, already stated, three leading circumstances which favor the most profitable union of labor and capital.

1. *First to be named is the general distribution of capital.* I mean such a condition of things that the capital of a country shall be in many hands rather than few—that laborers themselves shall have some capital. Whatever in the social organization creates or sustains privileged classes is opposed to this and needs to be removed. Whatever in legislation or usage by the easy allowance of public opinion tends to create or maintain monopolies, is opposed to this and needs to be especially guarded against. If no hindrances are in the way on the one side and no special protection accorded on the other, the natural working of things on the principles of self-interest will secure a pretty general distribution of capital. The end will be promoted by all measures which encourage saving on the part especially of laborers. Savings banks, such as New England has had and profited by for a century, or perhaps better yet a government savings bank through a modification of the postal order system, on the plan now in use in England, will be of great service in this matter. In large manufacturing establishments the stock may be divided into small shares and brought within the reach of the employes so as to induce them by their savings to become owners in part of the capital and so entitled to dividends from the profits in addition to their wages. Such measures elevate labor and give it inde-

pendence, and also increase capital by devoting much wealth that would be spent, to production. And capital thus distributed stimulates energy, develops talent, comes closer to labor, better defends itself and superintends operations by having in each operative an interested observer of both his own and others work.

2. A second circumstance to be considered is *the ratio of the whole amount of capital to the whole number of laborers and the ratio of the increase of capital to the increase of labor.* This only recognizes the principles before stated that industry is limited by capital and every increase of capital demands increase of labor.

No universal rule can be given for this proportion. It will vary somewhat according to the circumstances of each country and the spirit of its people. Here the age of a country must be taken into account—its natural advantages—the general occupation of its people. In a new country, occupied by a thrifty people, capital increases faster than labor, and there we see always the highest stimulus to production. For all countries and all people, the general principle is, that there should be labor enough to employ the capital and capital enough to employ the labor. A perfect balance is perhaps nowhere realized. Yet, if labor and capital are free, the flow of each under the law of competition towards an equilibrium is as natural as that of the waters of the ocean under the action of gravitation. In the order of nature undisturbed, there is provision for the steady increase of both capital and labor in something like a defined proportion. There is no danger of a surplus of either, for the whole world, nor for any one country, if only the passage is open for the outflow and inflow of either.

3. The third circumstance to be named is *the certainty that labor and capital shall each be made sure of a just reward.* The partners join hands each for an expected reward. Men will not

labor for nothing, nor will capital be put out in uncertain risks. To ensure this certainty of reward to each, there must be,

1. Division of property, personal ownership in everything that can by labor be made an object of value and appropriated. Without this capital can not be. On common property men will not labor except on the compulsion of force or stern necessity.

2. There must be also, security to all property-rights by both prevalent moral sentiment and just laws, equitably applied and faithfully executed. When governments invade or are weak to defend property-rights, capital withdraws itself into secret places as hoarded wealth, and labor is stinted and reduced to the lowest degradation. It is a terrible mistake to suppose that existing wrongs under which labor suffers can be relieved by that greatest of all wrongs the invasion or subversion of the rights of property.

3. And once more: there must be for both capital and labor, perfect freedom, unrestricted by monopolies or special legislation of any kind. A special favor in these relations of labor and capital involves an infringement of freedom on one side or the other, and that is an interference with natural law—a hindrance to the best results. The world is opening its eyes, after centuries of wrong and mischief, to the fact that the business of governments respecting these relations of capital and labor is simply to protect the rights of each and hold other things in even balance for the free working of natural law—to let both alone, giving neither any advantage, but both the utmost freedom. They are natural partners, and if not interfered with, will spontaneously seek each other as birds mate in the spring for a happy fruitful union.

There is not time, nor is this the place to discuss in detail *measures* for the better harmonizing of labor and capital. I will however, as we leave the subject, suggest a few thoughts which come as corollaries from our main proposition. It must

be acknowledged that through greater facility for organization, through false views which have gained acceptance in the current usage of business and through mistaken legislation in some things, capital has been unduly favored; it has the advantage and inclines to oppress labor. Laborers have some reason to complain and ask for relief. Justice and philanthropy require that every man who fears God and loves his fellow-man should consider the rights involved and lend a helping hand to the weak. But admitting this, it is obvious, from the views we have considered, that any measures which directly increase the antagonism between the parties, any organization which contemplates open war between labor and capital will only aggravate the evil and work damage to both sides. Combinations of employers on the one hand to set the prices they will pay—or of laborers on the other to agree upon what they will demand, and, in general, strikes and trades-unions are in this light positively mischievous. The great interests of both are common, and the true relief must come from the better understanding of those common interests.

On the other hand, all measures which tend to increase the intelligence and promote the thrift and independence of laborers and so inspire them with self-respect and confidence as they come into contact and union with capitalists are helpful. Co-operative associations which gather up the scattered capital of many laborers, to be used in the employment of their own industry, under their own management, may fitly be commended and encouraged. If capital has gained an advantage by special legislation, this is to be counter-balanced, not by special legislation to favor the other side, by attempts to fix the hours and the wages of labor, but by earnest united protests against all special legislation—by insisting on *freedom* as the fundamental law of productive industry. From the study of principles and the observation of facts within the range of my opportunities I am convinced that prominent among the sources of wrong to labor is the use of an unreal, ever fluctu-

ating currency. The control of that whole matter has been in the hands of capitalists. They profit by it, not through its relations to legitimate productive industry, but through the chances and stimulus such a currency gives to speculation. Capital invested in real production, and labor both suffer from it, but labor most of all; for in the ever recurring fluctuations wages are slowest to rise and quickest to fall, and all the mischiefs of deranged industry touch the very seat of life with laborers. Honest capitalists and laborers are alike interested in urging by all practical measures the correction of this crying evil. Freedom to work and honest pay for honest work well done is the universal maxim of wisdom for genuine thrift. The mischief is that thousands are studying and struggling all the time to thrive by the opposite rule, reaching on the one hand after the fruits of honest work without rendering honest pay, and on the other reaching after dishonest pay for dishonest work. The grand correction for this condition of things is a more sacred regard on all hands to that great command uttered by Jehovah at Sinai some few thousand years ago, "*Thou shalt not steal.*"

THE GERMAN SUNDAY.

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I venture to present, as a topic of social science, one on which it would be easier for me to *preach.* But while I do not for an instant concede that the Divine authority, and the teaching and practice of the Christian Church, are not to be quoted here, I recognize the wisdom and the value for our present purposes of rather choosing authorities and proofs from human and social history and experience. And, therefore, I shall hold in reserve what to many of us would be more conclusive than what I offer; but with the conviction that if on this, as on any other subject, we could *perfect* our social science—give the result of the widest induction and the soundest deduction—we might expect it in the language of that marvellous Book with which no *perfected* science has ever found itself in discord.

Europe inherited, no matter whence or how, the custom of marking one day in seven from all the others. And immigration brought that custom from Europe to our shores. It brought with it also two distinct modes of observance, which we may call the "English Sunday," and the "Continental Sunday." The influx from the Continent during the last twenty years, and the consequent strengthening of the latter mode, seem to have caused many of those disturbed by it to overlook some very obvious facts. The two modes of Sunday observance were brought here in the earliest period of settlement. While the English colonies, some of them under exacting religious convictions, enacted and practised the English mode, the French

and other European settlers were equally attached to the Sunday of their own old homes. And it was, indeed, a result of the old French war, as our fathers used to call it—the most momentous of all our wars in its results—I often think that the English Sunday was established as the custom of the country. In Lower Canada the French left their Sunday with their religion at that period, but every where else, in Canada and in the future United States, England planted her own usage as to the observance of every seventh day.

Unhappily however the importation of this English custom took place just at a period when the custom itself was a subject of controversy in the mother country. The Puritans had made it one of their leading purposes to reform the national habits of Sunday observance; had recalled from the Bible the name of Sabbath for the day; and were enforcing, as far as they could, the substitution of a strict Sabbath, like that of the Jews as they understood it, for the Sunday which the Reformation had left to the English people. Our sympathies in all parts of the conflict between the Church of England and the Puritans are likely to be biassed by our own present affinities, but it seems to me that any fair-minded man ought to look back to the two parties with a readiness to interpret the action of either in the light of the provocation of the other. They were about as wrong-headed in those days, as we are now, with the difference that it was a more earnest age than this in the maintenance of principles, whether civil or religious. The enormity of the "Book of Sports" on the one hand, is only explained by the the aggressive strictness of Puritan books and enactments on the other, and vice versa. Hence it came that when a Puritan commonwealth was founded on our shores, the Sabbath was imposed with all the greater strictness because it had been fought for in England. The rulers and people would have it and enforce it, and prove their doctrine about it by a demonstration. I need not quote the blue-laws which even made Sabbath-breaking a capital offence, and then by prohibiting

walking in one's garden, cooking, making beds, sweeping house, kissing one's wife or child, must have tempted men even to risk the halter. Those laws were soon repealed, but the Sabbath, down to the childhood of some of us, burdened men, women and children, specially the latter, with a load almost too grievous to be borne. And the natural result has followed, a reaction so complete, that thousands of the descendants of the Puritans have either given up the pretence of keeping the day holy, or are content with an observance for which their fathers would have put them in the stocks.

But meanwhile, during the progress of this history of the Sabbath, our population was being steadily recruited from the old world. And the new comers did not usually bring the Sabbath with them, unless they came from Scotland, where the Puritans had succeeded in planting it. But finding here either the New England Sabbath or the English Sunday, with which most of them were familiar, they confirmed and aided in the establishment of Sunday observance as the national custom and law. The immigrants from the continent, greatly in the minority, more or less conformed to American usage; and all over the land Sunday was marked from other days by the cessation of business, the public worship of God, and the general quiet and rest of our whole people. Within the last quarter of a century events on both sides of the ocean have turned the tide of continental immigration to us, and great changes have resulted in many directions. And one of these has been, that the continental Sunday has been brought to us by thousands, fresh from its own home, accompanied with such associations, and sustained under our universal suffrage, with such political power and other influence, that it threatens to usurp the established American custom and to reign in its stead.

I can but regard it as unfortunate for all who are rallied against it, that the reaction from the Puritan Sabbath has lost them so many allies. I do not mean allies in talking, but in

action and influence. The advocates of the continental Sunday may say to those on the other side: Your custom has had two centuries of possession of the land; it should be strong enough to stand; but we find thousands of your own people, if not welcoming our mode, at least weary of yours. Had all our English-speaking citizens been firm for our own custom, the new comers would have accepted it, in spite of their increasing numbers, as their predecessors had done. But having lost that vantage-ground, the friends of the old mode are disposed to strike very wildly and unreasonably, I must be allowed to say, in its defence and in attack upon the strange Sunday. Into the theological aspects of the question we do not enter here; but the most strenuous advocates of the Puritan Sabbath, or the one most shocked by the continental innovations, may well be advised not to waste breath, and risk his cause by surveying the field from no point of view but his own. There may be in the annals of human folly precedents enough for announcing, "Thus saith the Lord," with one's own interpretation of the saying, and then proceeding to style all who don't agree and obey, infidels and unbelievers. But I think it will be wiser to consider what is to be said on the other side before you band together against you all sorts of opponents, many of them of your own making by your process.

Here in Wisconsin our conflict on the question has been brought about chiefly by our large *German* immigration, and I shall speak therefore, henceforth, of the *German* rather than the Continental Sunday. If we inquire into the history of the German Sunday, we shall find that it has the highest sanctions of Luther and his brother-reformers. Those great men were but human, and could no more restrain the reformation-pendulum at once in its proper arc, than the rest of us can in minor-matters They found the LORD'S day included in a great number of church festivals and fasts, all put on a like ground of obligation, and burdening the people. Their reforming zeal undertook to discriminate between the Sunday

and the other days, among the latter retaining certain great festivals; but very jealous for the paramount authority of the Sunday. They were not agreed among themselves about the ground of its obligation, and as discussion went on about it, Luther, and even Calvin, and others were drawn into giving their authority to what seems to us lax observance of the day, in their fears of the people's relapsing into unreformed practices, or adopting views of their own opponents. For instance, Luther's saying, quoted from his Table-talk, "If anywhere the day is made holy for the mere day's sake, if anywhere any one sets up its observance on a Jewish foundation, then I order you to work on it, to ride on it, to dance on it, to feast on it, to do anything that shall remove this encroachment on christian liberty." And what he counselled, he seems to have done—and as it was a convenient mode of proclamation of reformed views and practices, one in harmony with the national instinct for outdoor enjoyment, whatever the previous Sundays have been among the throng of holy days, the German Sunday now was established with all the honors, and with all the earnestness, of the leaders of the Reformation.

Very sad, sometimes, are the evidences of human weakness, even in the case of great men, and of whole nations. We may wonder and lament that they did not reach the divine truth, instead of supposing that they found it in the contradiction of errors; but so it was. The religious earnestness of the time probably prevented immediate evils from their laxity, if we so regard it. But they bequeath it to less earnest generations, with the sanction of their great names, and with national pride associating them with it. So when you undertake to waive away, or condemn the German custom as a mere instance of infidelity, or actual hostility to the christian religion, you are very likely to array in its defence every German who hears you, from the mere instincts of patriotism. Whereas the Germans in this country are as much divided on the questions about the day, as we are divided ourselves between the Puri-

tan Sabbath and the English Sunday. Thousands of them not only are not infidels, but are contending for the Lord's day against infidel associations whose avowed object it is to desecrate and destroy it. And it is not more honest to confound friends with foes, than it is politic to make them all foes by indiscriminate attack. The custom is hallowed to them by education, by associations of their childhood, of their friends living and dead, their home and the fatherland. It is no more than plain common sense to look at it with their eyes, to admit what ever good there is in it, and to enlist their aid with some other argument than that our Sunday is of the Lord, while theirs is of the devil. And that is actually what they constantly have to hear upon the subject.

The love of out-door life I have referred to as a natural trait of the German race, and it is one which we Americans may well envy and imitate. I have seen a little bit of yard in a crowded city, containing a small grass-plat and a shrub or two made the chief scene of family recreation, despite the large and well-furnished parlor. And let it also be borne in mind that it is always *family* recreation which they seek; that in their simple amusements and pleasures, men, women and children participate. It is not their way to leave home and all its affections and influences and go to places and entertainments to which they cannot take their wives and sisters. All who have seen them in their own country will testify to the quiet and well behaved crowds which assemble in the gardens and parks, evidently not for entertainments—for in many of the most frequented none are allowed, still less for hard drinking or other vice, but for the enjoyment of their friends and of out-door life. I am not prepared to pronounce a Sunday afternoon so spent intrinsically less innocent than that of nine-tenths of our native population in which a special dinner, a lazy sleep, after the children have been sent to the convenient Sunday school, and the Sunday papers, are the chief employments, even when conscience, personal and traditional, forbids riding and

visiting and walking out. Let us make no naked issue with the Germans. In the Fatherland men whom all honor for their Christianity have followed the custom we condemn. To us, with our habits and opinions it would be wrong, but to them attending circumstances will make it right or wrong, and those circumstances I think we need to press upon them, waiving the question of difference of custom, until we can convert their judgments and consciences to our views of obligation and duty.

I have made no apology for the German Sunday, but only urge that it should have the full weight of the fact that our adopted citizens like it, not because they are sinners but because they are Germans. Feeling an intense anxiety that our English and American custom should prevail, I wish to point out the injustice and impolicy with which the matter is commonly treated. And now granting all that has been admitted, let me urge some reasons why the German innovation should be resisted in all proper ways.

That some consideration is due from them to the feelings and habits of the country which so heartily welcomes them, the intelligent among them would readily admit. You cannot imagine an American crowd invading the rights and customs of a German community, as they have done ours. It would not be tolerated for an instant. The day we reverence as of God's appointment, the quiet and order we desire for it, the undisturbed houses of worship and burial places of our dead to which we are surely entitled, the influence and moral atmosphere we would keep about our children—all these are invaded by strangers within our gates. We give them citizenship and all its privileges, even suffrage and political power, and they trample on our ways and feelings, saying that they have rights as well as we. I have known a beer-garden to be opened almost at the door of one of our churches, and the services broken in upon by the blasts of a brass-band. I have buried the dead to the music of a waltz and the laughter of a

merry crowd while the mourners were almost jostled at the side of the grave by other Sunday idlers. Our Sunday Schools, on which we depend, foolishly enough, I grant, for the religious teaching of thousands of our children, are commonly depleted of the boys during the summer months, because of the attractions and excitements of the gardens. The vicious of all nations, our own included, find on Sunday both their strongest temptations and their best opportunities. Thousands of men, women and children are robbed of the rest of one day in seven to minister to the pleasure-seekers. The moral sense of the community is debased and weakened by the example of the violation of law, and the victory of pleasure over restraint. Nay more, it has come to be the settled and avowed determination of associations of men to compel the day's desecration; to choose it for public celebrations, to repeal all restrictions and restricting ordinances; to release the American people from the superstition of Sunday observance.

Now for these evils, which justify my subject on the present occasion, for these evils who are responsible? Not we, say many of our Germans. If we were left to ourselves, many of these excesses would not occur. We never had them in our own land, we have no desire for them here. Vicious Americans, Irishmen, and others interfere with our quiet; so much so that many of the gardens we never visit, nor can we take our wives and children to them as we used to do at home. This has been often said to me by respectable Germans who at the same time were offended by the denunciation of their custom as all evil. And they were right, and yet admitted all the charge. Granting all that they can say as to the harmlessness of the Sunday in the Fatherland—for that is not the point of discussion—it cannot be harmless here. They exchange a society of one race for one made up from all the nations of the earth; a society, of defined ranks and orders, for one in which

all men, from the highest to the lowest, have equal rights; a society under strict law absolutely enforced, for one whose police regulations and administration are swayed by the popular breath; a society accustomed for centuries to the Sunday, for one in which it is an innovation, a step of decline, a liberty which instantly passes into a license for immorality and vice. And good citizenship—may I not say, sound social science—demands that they should look upon the custom as one that cannot be transplanted from the Fatherland. There it may continue as they have known it; there they may enjoy it when they return to visit or to dwell. But here, in return for American opportunities and rights, which, they would acknowledge, repay for all such sacrifices, they must be content to give up the custom, or be held responsible for the flood of evil to which it opens the gates.

As, however, my opinion and advice are not likely to bring all the Germans at once to give up their Sunday, I think there are some measures that we Americans should take for our own protection. Every city and large town should have its own public gardens and grounds conveniently situated in the outskirts where it will interfere with no worship; made as beautiful and attractive as possible, and on Sunday under special police regulations and oversight. The Germans at home have their beer gardens, private establishments, and also palace gardens and such public parks where no beer is sold no amusements provided, nothing but the heightened beauties of nature and convenient seats and look-out places, and so on to enable all to enjoy them. Now let the public provide the the latter kind of resort here. Our own mechanics and laborers need it, shut up as they are on all working days, and having but confined and close homes. Suppress with a strong hand the sale of liquor, and indeed all buying and selling on the grounds and in the vicinity, and everything like disorder. Then all that is innocent and valuable in the German custom will be within reach, while the vicious of their own and other

nationalities will be kept down. And the only servants of the crowd who will lose the day of rest which mere human experience, apart from the Divine Law, has pronounced to be absolutely necessary, will be the police, whose apportionment of duty may save them even that loss. If any are disturbed by the suggestion of allowing and encouraging such laxity as this, I have only to say that having made this provision to prevent a great abuse, it will then be the field of effort of all christians of all names in this free country to bring the people up to the standard of religious observance, which they may severally regard, as a matter of obligation under Divine Law. It does not follow in every instance that a man's view of the Sabbath, or the Lord's day, is such that he can win the others to its adoption. And it may be that the reason is in the view itself.

I have wished, in this paper, to indicate what seems to me the right line of argument on a difficult question, and to condemn the one which is usually taken as impolitic and unjust. It is one of a great number of topics belonging to this section of the Academy, growing out of the relations of our American and foreign born citizens. And on all those topics I venture to lay down a proposition by no means new, and yet being constantly forgotten, in legislation and in social problems, one under which all that I have said, when restraining myself from religious arguments, might perhaps have been included—that foreigners, on becoming citizens, should become Americans as far as possible—that neither in language, nor schools, nor churches, nor in other social or political relations, should they be encouraged to perpetuate their nationalities. It is true that they must mingle with us in a generation or two, but no little evil is caused by their efforts to keep themselves apart and by the politician's concessions to this natural but mistaken desire.

SOCIAL SCIENCE AND WOMAN SUFFRAGE.

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The English periodical, *Nature*, reviewing an essay of Huxley's on what it calls "the irrepressible woman question," makes the following statement. "We are confident that this question is one which must be ultimately settled mainly upon physiological grounds, and it is just because the conventions of society very rightly do not admit of the full and fair discussion of those grounds before mixed audiences that the extreme emancipationists have been enabled to obtain for their theory the amount of currency which has fallen to its lot." It would seem, however, if the conventions of society forbid the discussion on the platform and in the parlor of the most fundamental aspects of one of our gravest social problems, that there ought to be some method devised by which such material matter may be brought prominently before the public mind. Human society cannot be preserved if matters which are of primary import cannot somehow be subject to open and general consideration. Social Science, if it is to have any value at all, ought to adapt itself to such exigency. The object of this essay will be to suggest thought mainly upon the physiological features of the question of suffrage for woman.

So far as the advocates of political franchise for woman have gone, their position seems, in the main, to be correct. We accept the most radical theories of "rights" that have been propounded. We maintain that "governments derive their just powers from the consent of the governed."

We have no confidence in the distinction so often sought to to be made between natural and political rights. Political rights grow only out of natural rights, and of these latter woman has as many and as comprehensive as man. And if the agitation which we are having on this subject shall explode the notion that man has some royal political prerogatives over woman, it will have done a good work toward settling a basis of correct ideal of the relation which should exist between the sexes.

We challenge also another of our political aphorisms commonly regarded as axiomatic; to wit—that rights and duties correspond. This is only ideally true. It cannot be pressed in practical life. We may have rights by the score without duties attached. The man who stays by the bedside of a sick wife or child, may have the *right* to vote. The *duty* may be not to vote. So long as it is a question of "rights," we are convinced that the *right* of a woman to vote is as good as that of a man. But we have not solved the problem of society when we have thought along the single line of personal rights.

When in practical life all questions are considered, it may not appear to be the duty of woman to assume active participation in politics. With the same inherent right to have share in political affairs as man, woman may nevertheless refuse to consider it to be her duty, either from the consciousness that nature has assigned her sufficient duties of another character, or that she has already assumed a sufficient number of her own choice.

We see no insuperable obstacle why government may not sit firmly in the "consent of the governed," though half of the governed be women without the ballot, not even if the statute gives the ballot to males exclusively. That statute may and ought to express the consent and conviction of woman as well as of man. We hope the discussion respecting "rights" will be continued till this result is attained. Let no government over woman rest on the suspicion of might or of

prescription. If man retains the sole agency of society in political affairs, let it be only upon assent by woman after examination of the whole matter had. We predict that such assent will ultimately be given.

We discard all theories of woman's inferiority. We believe that woman *can* do what man can do. Possibly man may have some advantage in power of brain or brawn, and in endurance. But the advantage is not so great that woman cannot keep near enough to him in any kind of activity to be a helpmeet for him. And it is a matter of common observation that the helper is often in all respects superior to the helped. If in anywise woman be inferior to man, we regard her as having also compensating superiorities. We do not oppose the entry of woman into politics, because we suspect her of incapability for its emergencies. Given a common field to woman and to man, and we will grant substantially equal results.

But if woman is to be a wife and mother, the inquiry arises: Does she want a common field? Is it wise or prudent to attempt to cover the ground of all man's activities, and discharge the functions of motherhood beside?

Marriage constitutes a special condition for woman, as it does not for man. Yet the vast majority of women pass into this special condition. Married woman is the dominant and representative element in the class woman. A social scheme for woman, founded on her condition as *femme sole* would be playing Hamlet with the part of Hamlet left out. The bearing which the assumption of political duties by woman will have upon this special condition, needs to be closely scrutinized. Suffrage, and all the burdens that follow with it, will be opened to woman near the years in which, as a rule, she enters upon the responsibilities of marriage. The question is, does woman, as she enters upon those responsibilities, want to assume the department of politics beside? If the *married* woman does not, is it wise to open the department to women at all?

The cry of the mother from an average home now is of over work. Grant that this comes from the ignorance and sin of man, yet woman's assumption of the right of suffrage will not put the millenium in his heart. It will not take an ounce from the burdens already pressing. It will simply add the distraction of one more. The great source of misery to a married woman now is that her maternity is regarded as only an incident in her life, while during the months and years in which her vitality is consumed by it, it should be regarded as the sole end. Maternity is duty assigned and enough of duty. Instead of asking if woman cannot assume some other duty, the attention of society should be directed to devising methods of relief from the necessities that now press upon her. Beyond what nature imposes, a mother's duties should be optional. And yet she is asked to assume another duty which ought to be inexorable wherever it falls.

We see often in the high quarters of the advocacy of suffrage for woman an ignorance or an ignoring of the physiological bearing of the question that is astonishing. A far-famed and much respected supporter of the so-called reform hails the good time coming when "marriage and motherhood no more complete a woman's mission to the world than marriage and fatherhood complete a man's." We grant that a married woman may have other aims in view besides what maternity imposes, *but she cannot have such aims on equal footing with man.* If she is to be a mother, these other aims must be held by her in a comparatively subordinate position to that in which they may be held by man. Marriage and motherhood *do* complete a woman's mission to the world more than marriage and fatherhood can complete the mission of a man. It would be impossible to secure equality between the sexes here, even with "just men made perfect." God has drawn the fiber of woman around motherhood with a tension he has not put upon the paternity of man. Marriage assigns function and destiny to woman as it does not to man. What kind of wild reason-

ing may we not expect when the enormous difference between the physiology of maternity and of paternity is sunk from sight?

The entry of woman into political life means burden, if the event is to have any significance at all. If woman is not going to reform politics and government, she might as well let them alone. But if she is going into the work of political reform, she will find there is something to be done beside the holiday sport of riding to the polls at elections in gaily-bedecked carriages, with streamers flying,

> **"All the while**
> **Sonorous metal blowing martial sounds."**

If she is to improve the present condition of things, she must master the science of government and the arts of politics; she must attend caucuses, and plod through the weary work of the investigating committee. Unless she does this with an energy and purpose not now practiced by men, where will be the gain to society from her advent into politics? Remember now the fact that the strain in politics comes in just those years when the functions of maternity make their demands. If woman is to be a helpful element in political affairs, she must be a *constant* element in it. One of the most serious portents of our politics now is the lack in men of steady and persistent action. Senator Wilson, of Massachusetts, in a late review of the situation of affairs in the city of New York, puts the responsibility for the disgraceful condition of things there existing upon the men who were entitled to the right of suffrage and did not use it. But all motherhood ought to have no sense of care or responsibility for politics. It is idle to say that those upon whom the burdens of maternity are actually resting, either prenatal or past natal, may be allowed the privilege of retiracy. If from time to time, as she emerges from retirement, a mother is to be of any help in politics, it must be because she has the while carried it along with her.

Two years of dismissal of it from the mind in these days is to take a Rip Van Winkle sleep upon it. It may be said that men neglect politics when they please; and it may be asked why women may not do so also. The answer is, men do neglect it; mothers ought to.

The appearance of woman in politics then means her constant agency in it. It must take that form or our politics will be swept by the lower stratum of society with majorities such as we never heard of before. The mothers there will be governed by neither reason nor delicacy. They will appear at the polls let what will of maternity betide. And then must come our appeals to the mothers of culture and refinement not to allow our system to be swamped by the votes of the stolid and ignorant. Now remember that woman is particularly impressible to duty. Remember that motherhood from its peculiar physiological conditions is especially sensitive to excitement; then think of a presidential campaign and ask if the considerations from physiology alone are not sufficient to warrant shutting the gate against the possibility of bringing the sense of duty to bear on the mothers of our land, in such times of passion and agitation? The *Independent*, a firm and reasonable advocate of woman suffrage, says with respect to suffrage as it now exists: "Not to vote is an offence against society as stealing is an offence." That is right. And that is bringing the sense of duty home to men as it ought to be brought. But will you lash motherhood to political action with any such scorpion? Yet it must be done if she is to step into the political arena to take equal responsibilities with man. Voting is not all of the matter. Behind the vote must be planning and care and anxiety and effort that the election go rightly.

The physiology of this matter must somehow be brought to the front in the public consideration, unless we are willing to take a Niagara plunge on folded oar.

To ask woman to take up the department of politics ought to be considered an imposition upon her.

Our civilization or our barbarism has already added too much to her duties. We have added now so much that she has to let department after department of culture and social activity drop from her grasp when she takes up from nature the great office of maternity, and they lie in neglect and confusion around her. And yet we have the coolness to ask her if she could not possibly stagger under an additional burden.

> **"The harp that once through Tara's halls**
> **The soul of music shed,**
> **Now hangs as mute on Tara's walls**
> **As if that soul were fled,"**

is the requiem that almost every young mother has to sing over many a discontinued accomplishment. With no time now for music, art and literature, we propose to ask her if she will not spend a few days on an investigating committee, on the accounts of the keeper of the house of correction, or prepare a speech for the next ward caucus in favor of vacating an alley in somebody's addition.

The matter seems ridiculous. But just where ridicule seems now to come in it is more than possible that a cleft might be made for the entrance of the sense of duty if suffrage be opened for woman.

Woman must stop somewhere or break. She cannot discharge the functions of maternity and assume all the departments of man's activity beside. This is as sure as the doctrine of the conservation of force. In fact that doctrine underlies the whole matter. When the forces of the system are taxed to their utmost in one direction, if severe efforts in other directions are assumed, it is in vain to expect to avoid catastrophe.

Right here is the place to look at the bearing of this matter of suffrage upon the question of the education of woman. We are now attempting to carry up the public education of our young women to the same grade as that of young men. We believe with due care for health and physical development, this

may safely be done. But even this will be physiologically defensible only on the ground that the young woman's competition with the young man shall cease when she enters the marriage relation and the forces of her system are directed by nature to maternity. Woe betide the day to her offspring if she attempt to carry it on then. There is exhaustion in any system of education. It may be but healthy exhaustion if we stop where nature has marked a pause. Your high systems of culture for women will take their place only as part of a general system of physical debilitation, if the struggle for equality with man is to continue under the extraordinary tax of maternity.

Why woman needs a culture equal with man before marriage, is *because* she must or ought to cease when she comes to motherhood, from the efforts he can continue to make. If the same tension that he can endure is kept on her continually, and then she assume maternity beside, her thread will part.

By and by, if we are not wise, we shall have a rebellion against the attempt to open our higher systems of education to woman, when the real trouble may not lie in this preliminary work of life, but in the attempt to run an equal race, carrying double burdens afterwards.

Now if there is any one department of man's activity that woman can afford to let him bear alone, it is this one of politics. She ought not to be so alien to her own nature but that the sweet influences of maternity can compensate her for anything man finds in political life. Politics is but pure drudgery to the mass of *men*. So much is this so, that the great difficulty is now to get *intelligent men* to endure its irksomeness. Doubtless almost anyone would be willing to accept some office high in rank and flush with salary. But these places are only for one in hundreds of thousands of men now, and a mother would rarely or never see them if woman had suffrage and was eligible to office. Motherhood in solid phalanx would be remanded to the wearisome, distasteful tug of

work to which most educated men are bound only by a sense of duty. It is not the highest style of manhood that is led captive by politics; and how a woman can become enamored of it is "passing strange."

Politics represents rather the friction of society than its conserved energy. It is a low state of civilization where much of social power is turned into its channels. When you hear a great din in politics you are only listening to the *creaking* of the wheels of state. When politics runs high, arts, industries, sciences and education are apt to be running low. You can see this illustrated in the difference between the south and north divisions of our own union. The south for generations has consumed its energies in politics. It has simply been burnt up in its own excitement, and it has nothing to show for it. The great unfilled vacancies of the south on a railroad map, are testimonies to the desolation that results when society makes politics a prime ambition. Viewed as an industry, it is the most precarious of all methods of meeting the problem of subsistence. What chances it offers could scarcely be open to *mothers* at all.

Neither need unmarried women look in this quarter for any hope of solution of their difficulties. One of the most pitiable objects among men is the stranded politician. If a woman has failed to secure a life companion, she need not give her heart to politics. Politics can jilt as well as an individual. It is proverbially fickle. Heaven forefend an unmarried woman from adding to her man-forsaken plight the condition of a bankrupt politician, forsaken of the gods. Politics is not an industry. As an industry it has done nothing for man. It can do nothing for woman. At any rate it has nothing for motherhood but burden.

The prizes which a few women might possibly draw in politics cannot compensate the disaster of precipitating the incubus of its dull, repugnant, fruitless toil on the great mass already oppressed.

Why should women attempt to carry along everything? Men cannot do it. The advocates of woman suffrage often attempt to ridicule woman because of her ignorance of politics and related subjects. They attempt to constrain her to demand suffrage, to save the point of their lampoons.

But why may not women let a department go as well as men? Why may there not be some departments that they may not care to assume just because they are women?

In this age we are making our great strides in progress because we are respecting the principle of the division of labor. Is it inconceivable that that principle should sometimes fall between woman and man as it does between woman and woman and man and man? A genius cannot prosecute everything in these days. It was no disgrace to Senator Carpenter, to say, as he did the other day, that he knew nothing of chemistry. A professional man cannot cover the ground of all the outside knowledge there is in the world. Nay, even a man cannot carry all that was once reckoned as belonging to his own profession or handicraft.

We are gaining success in our civilization just because we are specializing so much.

One of the foremost lawyers in Boston recently remarked that he hardly knew the meaning of facts in admiralty. He had devoted himself largely to the law of patents. "The dog that ran after two hares caught neither," is the expression of some very old wisdom. But opportunities for its application are multiplying every day in the increasing complexity of civilization. Suppose woman is ignorant of politics! It is just possible that it may not be worth her while to know much about it. It is possible she can put her mind and energies to some other matter to better advantage to herself and society.

We do not believe there can be any very serious conviction among women that they *need* suffrage for their political or legal protection. Certainly the legislation of this country for the past generation has been swift to enact every well defined wish

of woman. If not every wrong which the clearest minded can see that legislation can touch is instantly righted, all can see that there is a tendency in legislation in the hands in which it is now placed, to rectify all known injustice to woman. But legislation has not yet managed to anticipate all the wants of man. It will hardly be able to do so in the case of women. If women have wrongs that are subject to remedy by legislation, let it be remembered that the general law is that wrongs must be endured till they are smitten into the general sense of society as wrongs, before it is wise for legislation to meddle with them. We have been so hasty to execute any wish of woman that the wisdom of some things done is questioned. If any thing has appeared clear, it is the right of a woman to dispose of her own property. But even the wisdom of that was challenged by a woman the other day in a prominent periodical.

It was claimed that the right of a widow to dispose of her homestead, in practice brought evil, and that such right should be taken from her. Let it be generally felt throughout society that it is an evil, and does any one doubt that its correction can be secured through the present system of legislation; though to do so would be just to box the compass in the attempt of legislation to meet the wants of woman. The question recurs, do women to secure fitting legislation for themselves as a class *need* to assume the burdens of suffrage?

There is one other respect in which the physiology of motherhood is seen to have even a more important bearing upon this suffrage question than in the matters already considered. What has thus far been treated relates almost entirely to the welfare of the mother herself. We shall look now to the welfare of her offspring. The Saviour, on an important occasion in his teaching, took a little child and "set him in the midst." If we oftener imitated his example in social questions, we should less often commit blunders. The child is the key to the whole position. If we are worthy the name of Social

Scientists we shall look to the well-being of the coming generations. If we do this we shall see why it is that the *mother* comes to the fore front in the consideration of the question of suffrage for women. The next generation is the gift of the motherhood of this. We need to scrutinize this movement for suffrage to see if it does not have more particular reference to those who are not mothers, than to those who are—to woman out of the ordinary family relation rather than to those in it. If it does, the probabilities are decidedly against it as a movement in the interest of posterity. The very first claim that one generation has upon that which precedes it, is the transmission to it of sound physical constitutions. Unless this is done, the gift of being under ever so favorable a condition of "rights," will hardly be worth thanks.

The question is one of direction of vital force. Where shall a mother's energies, go—to politics or to her children? Is our politics in such need of the efforts of mothers in it, that to rectify it we must rob our children of the flush of vitality? Of course this argument is good for nothing if no power is to be put forth in politics. But if power is not to be put forth, again we ask what significance there is in woman's entry upon it? This argument too has no validity, unless the mother in an average home is already an over-burdened factor in society.

We desire here to give credit to Gail Hamilton as the only writer whose works we have read who seems to have a proper conception of this matter we are now considering. To the often asked question why the women of this generation cannot do the work of their mothers, Gail Hamilton replies "We cannot do the day's works our mothers did *because* they did them." We regard that reply as containing philosophy enough to cover this whole suffrage question. The spinning wheel and loom of our mothers consumed vitality that should have come to us. There is an everlasting weariness on us all who came out of the average well-to-do homes of the past generation—the legacy of the over-work of our mothers. The mothers "ate

sour grapes and the children's teeth are set on edge." Not only the iniquity but even the frugality and industry of mothers may appear in curse upon their offspring. You cannot cheat the law of the conservation of force. You cannot break the line of continuity between generations. Nature goes down through all and if she cannot collect her forfeitures of the guilty she will of innocent offspring. We are convinced that before suffrage is taken up by woman we need a great deal more of consideration given to the probable influence of the assumption by motherhood of greater work than she now performs upon the well-being of posterity.

It is not simply the "personal rights" of the generation on the stage that is concerned in this matter. We stand in thoughtful pause before a question Coleridge asks: "Can anything be more dreadful than the thought that an innocent child has inherited from you a disease or a weakness, the penalty in yourself of sin or want of caution?"

We question whether our social or domestic life would gain anything in value from bringing forward politics as a more prominent element in them, as must be the result if woman is compelled to take up this new department.

After a mother has performed the home duties which the day imposes, we question whether it would be profitable for her to spend her time in studying and expounding to her family questions pertaining to tariffs or civil service. It probably is important to determine how much a sheriff's fees should be or whether the government duty on indigo should be two shillings or two and six per pound. But we question whether it would be a step upward for a mother and her children to pass to these matters from the music, art and literature which now adorn or ought to adorn our homes.

There is one collateral matter to which we desire to allude, and that is the matter of inequality of wages. Now we do not for a moment argue that there cannot be nearer approximations made to justice in this matter than we now make.

But as a general rule, is there not justice in the present arrangement that a man should receive more pay for the same work even, than a woman? Ought not *family* wages to be more than the wages of an individual? And ought not a husband to be charged with the responsibility of earning the family wages? The working factor of the family ought not to be the wife. The line of labor through which the family living comes, ought not to be prosecuted by the wife. Saying nothing of sentiment, physiology forbids it. The *man* who goes forth to work, represents not only his own needs, but those of wife and children behind him. He must receive more wages for his work than an unmarried female who is his competitor, or the possibility of maintaining the family relation in society is at an end. It may be asked, why speak of his competition with an unmarried female? why not look at the case of a widow with children to support? The reason is because the case of a widow with a family to care for, is an exception to the rule in the case of families. We should occasion more misery than we should relieve if we were to equalize wages to meet her difficulty. Her case must be met in some other way than by putting all the families of the land down upon the footing of competition with those who have only the needs of a unit to supply.

If it be asked, why not give the unmarried of each sex equality of wages? The answer will be that this in effect will only be to make them both competitors against families at lower rates than those on which families can be supported. And a further answer is because the adumbration of marriage is over them both. If man ought to earn the money from which the support of families comes, it is difficult to see how the general rule can be otherwise than that the wages of man ought to be greater than those of his female competitor. The main work of life for which wages is paid is done or ought to be done by married men. If young men unmarried, as against young women unmarried, so far as wages are concerned, are

reckoned with married men, it is because "coming events cast their shadows before." They may both be reckoned now for what, as a rule, they are to be. The injustice is not great in reckoning man from the beginning as the wages-producer and compensating him as putatively responsible for the maintenance of a family. The wife at marriage enters into the enjoyment of any surplus the husband may have gained. If this discussion is not understood, we would like to ask a question which, we think, can be understood.

When the wages of women are everywhere equal to those of men, how can a mechanic hire the female assistance which his wife again and again in her motherhood must need? His day's wages can only offset the wages of the help he hires and then where shall the family subsistence come from?

Unjust as the present system of wages may often seem to be to woman, it is questionable where we can put our hand in to remedy it, without doing more damage than benefit. We are convinced that no system of reform respecting wages can be sound which does not plant itself immovably by the side of woman *married* and regulate everything primarily in the light of her highest interests.

We are pushing the principle of inviduality to a destructive extreme. It is a surface question in sociology to ask simply if the wages of one individual ought not to be equal to that of another for the same work. Behind this lies the question "ought not families to be supported, and how can this be done?"

Business with its great motto, "You buy best where you buy cheapest," has respect only to this principle of individuality. But the interests of business are a narrow foundation on which to rest a social system. A society that followed business maxims only, would be barbarous, infernal. If social science desires to be of service to humanity, it must impress society with the idea that the necessities of *families* must be looked to in settling the principles of compensation for work. When this is done, other things being equal, we shall find that

in competition for employment, preference will be given to married men, and that there will be discrimination in the rate of wages in their favor. Thus shall we render aid to the greatest number of women, and to the class most sorely needing it. Here let it be said that the great social question before us is not how units of either sex can take care of themselves. The subject of prime importance pressing upon us is not the matter of opening new avenues of employment to women who are out of the ordinary family relations. So far as the "struggle for existence" is concerned, there is no one now in our society more favorably situated than an unmarried female willing to work, no one who has less difficulty in maintaining an honored social position. *The great social question is how to lighten the burdens of women in an average home*, how the wives of farmers, of mechanics, of laborers, of men on small salaries and men with moderate incomes may assume motherhood, without the grave or an insane asylum in the near prospect. In other words, the great question is how a *married man* can properly provide for his family.

We want to enter a protest against the philosophy of John Stuart Mill respecting the social position of woman. He asserts that because woman has never been on practical, political equality with man, that therefore we know nothing about her or about her appropriate social position and function. That we have nothing for it but to try her in every new position as it is proposed. But if all human experience has gone for nothing, all human experience will go for nothing. If the human race has not hit the *high road* of nature in this matter hitherto, there is little likelihood of its *ever* striking it, or of ever knowing it if it did. If something like the great law which has prevailed in all time, across the whole social scale, from the wigwam to the palace, by which the exoteric duties of a home have been assigned to man and the esoteric to woman, we may despair of being able to find any regulative principles whatever. It has not yet become folly in other depart-

ments of our social life to be guided mainly by experience and to attempt the untried only with circumspection.

The great body of our liberties stands in common law. Our special charters have added little or nothing to them. There is little in Declarations or Bills of Rights or constitutions that would not have been law without them. These great documents that we invest with so much of historic interest were but little more than codifications and reaffirmations of existing liberties. Yet our common law so rich for us in its beneficent privileges is based on the fundamental principle of respect for past experience. Its first motto has been and always will be "stare decisis." Its first principle of philosophy has been that human experience is a safer guide than human speculation. True it has adopted new principles under new exigencies, but never without an examination that sifted the elements of the case to the bottom, and subjected the finest comminution to inspection. A man who thinks he has a new principle to engraft on common law may look upon himself as one of the elect of the ages. So thoroughly are our liberties grounded in experience. Yet in a social matter of as much importance to our happiness as anything the common law secures, Mr. Mill advises us to launch out on an "unknown sea" without chart or compass from experience and make what port we may. And there seems some danger that we may follow his wild philosophy. So far the question of suffrage for woman has had little but superficial treatment. The fundamental questions involved have hardly caught the public attention. That there are evils attending the adjustment of the social relations of the sexes we do not deny. That some of these evils may be removed and perhaps all mitigated, we do not deny. But we can hardly expect to remedy all at once by an inversion of the foundations on which society has hitherto rested. We shall do better to do as has been done in common law—(and by the doing of which it has earned the name of common sense), look at our specific evil and apply a specific remedy and then stop. The most daring

innovator in common law, Lord Mansfield or Byron Paine, never dreamed of revolutionizing the whole legal fabric when it was necessary to reverse a former decision or lay down a new principle. He pruned simply what was effete. He introduced just what was required for the case in hand. He did not try to make his reform so broad as to cover all possible contingencies of the need of reform.

The evil of this suffrage movement for woman is that it asks for more than is needed. In the attempt to relieve certain evils it brings greater calamities than it cures. It prays for the deluge, to carry on irrigation. The question of woman's wrongs needs to be divided and considered item by item. Remedies can then be devised that will meet intelligently the case in hand. If it seem best, we can advance so far as to make woman eligible to all office. We can do this without compelling the whole class to take up suffrage. If a woman wants to enter political life let it be a matter of option with herself without compelling all womanhood to drag through the drudgery of politics for her sake.

While society exists in anything like its present conditions, suffrage ought not to be imposed upon woman. The only result will be to add to an already oppressed class the heavy burdens of our political system.

THE PRESENT CONDITION OF THE COMMON JAILS OF THE COUNTRY.

BY SAMUEL D. HASTINGS,
Secretary Wisconsin Board of Charities and Reform.

The questions as to what shall be done with the criminal classes? how can society be best protected from their depredations? how can their numbers be decreased? what can be done for their reformation? how can their condition be improved? and others of a similar character have occupied the thoughts of not a few of the statesmen, philanthropists, and christians, not only of our own country but of all the civilized countries of the world. Prison associations have been organized in different States of the Union and in different countries of Europe; able reports have been made by these associations and by legislative committees; a national prison congress was held in the city of Cincinnati, in the month of October, 1870, from which emanated papers prepared by some of the ablest and most learned men of this country and of Europe. Through these various instrumentalities, and through these different sources, much valuable information, in answer to the important questions suggested, has been spread abroad, and much has been done to enlighten the public mind touching these great matters.

One of the results of the national prison congress held at Cincinnati was the adoption of initiatory measures for the calling of an international congress.

The Rev. Dr. E. C. Wines, for many years the corresponding secretary of the Prison Association of New York, was appointed a commissioner or agent to make the necessary arrange-

ments for the holding of such an international congress. He has since visited the different governments of Europe, and has everywhere found an entire willingness on the part of these governments to co-operate in the movement, and, as a result, arrangements have been made for the assembling of such a congress in the city of London, on the 3d day of July of the present year.

There is but little doubt that all the governments of Europe will be represented in this body, and it is earnestly hoped that representatives from all the States of the Union will also be present.

As one of the results of the investigations which have been made in relation to the condition and wants of the criminal classes, some most astounding developments have been made as to the condition and influence of the common jails of the land.

In a brief paper of this character, I shall attempt nothing more than to present, chiefly in the language of others, a few facts and suggestions touching the matter under discussion.

In the report of the "Special commissioners to examine the penal reformatory and charitable institutions" of the state of Michigan, made to the Governor of that state during the past year, is found the following:

"Ours has been the experience of all who have undertaken to examine the actual condition of county jails, whether in this or in other states.

"Their condition is wretched beyond all power of description, and beyond all conception of those who have not had the experience of their own senses in the matter.

"There are, of course, marked differences in the condition of the jails; some few, *a very few*, are subject only in a slight degree to the sanitary objections made, but we speak of their condition in general.

"The defects in them are not owing so much to the manner in which they are kept, as to inherent defects in their construction, their dilapidated condition, and a fatal vice in the common jail system.

"For the most part, our sheriffs are both humane and competent men, and as a general rule the prisoners are well fed, and treated with a reasonable degree of personal kindness.

It is an acknowledged fact, that light and fresh air in generous measure are absolutely essential to a healthful condition of both body and mind. For the most part, our jails seem ingeniously constructed to exclude as much of these essential elements of health as is possible without destroying life.

"Nor is any proper provision made for cleanliness of person. Many prisoners come to the jail filthy in person and in clothing. They are thrust into long, narrow, dimly-lighted, badly ventilated corridors, from which open the cells. There are no bathing requirements or facilities, and prisoners are not always required even to wash their hands and faces. This corridor is used as the sitting and eating room of all the prisoners, clean and unclean, and is often also, the privy and water closet of all; and if not, the privy is closely adjoining, and the corridor is filled with its fetid and sickening odor.

"The cells are very small, usually not exceeding in size four or five feet by eight, and seven feet in height; without ventilating flues, and with absolutely no light or air except such as steals through the iron grates of the narrow doors opening into the corridors. No breath of pure, fresh air ever reaches the inmates. Yet in these cells, alive with vermin, poisoned with the stagnant, fetid air, the prisoners spend one half of their time; and when too sick to creep out into the corridor, the whole of it. *

"The larger proportion of the persons confined in our county jails are confined awaiting trial, and they are often detained month after month.

"They are not convicts and the law presumes them innocent. Experience shows that a portion of them *are* innocent of the crimes with which they are charged, while a much larger portion of them are never convicted.

"The power to arrest and detain persons charged with crimes is one essential to the public good, but it is one that is often abused by the malice of accusers and the reckless carelessness or corruption of officers; and innocent persons are not unfrequently the victims. But we submit that whatever right the state may have to punish convicts by depriving them of sunlight and pure air, thus destroying health of body and mind by such incarceration, it has no right thus to treat persons who are simply accused of crime and are awaiting trial. *They*, at least, are entitled to such of the decencies and ordinary comforts of life as may be consistent with safe detention.

"The moral condition of our jails is infinitely worse than their sanitary condition, and after a full examination and careful consideration, we have come to the clear and painful conviction, that they are the very hotbeds and nurseries of vice and crime, and that the state is directly responsible for a large share of crime which it seeks to punish.

"The general plan upon which jails are constructed is that of corridors, with cells opening therefrom. The prisoners are locked in their cells at night, but during the day they congregate in the corridors, without employment and without oversight or restriction as to intercourse.

"There is no separation of the convicts from persons merely accused of crime. Here, often, are gathered those old and hardened in villany, lost to shame, proud and boastful of their crimes; those who have committed their first crime under the influence of some strong temptation; those who have committed some venial offense while under the influence of intoxicating liquors or some sudden passion; mere children in the paths of vice; those who are accused, but are entirely innocent of any crime; and those who are arrested on civil process and are unable to find bail.

"If the wisdom of the State had been exercised to devise a school of crime, it would have been difficult to devise a more efficient one. Here are the competent teachers, the tractable pupils, the largest opportunities for instruction, with nothing to distract attention from the lessons. Those merely accused and those guilty of a first offense, however venial, are taught that the mere fact of an imprisonment has shut them out from all the avenues of respectable industry; that there is no hope in that direction; that society has become their enemy; and that the only course open to them is to become the enemy of society. They are taught how to do this most effectually, and that the chance of detection and punishment decreases just as one becomes skilful in crime; and all the arts, devices and exploits of the experts are taught in detail to listening and wondering ears, who soon learn to admire the audacity and skill described, and to long to imitate and excel such display of them.

"Gambling is a common amusement, and the tricks of professional gamblers are learned. The jails are often so arranged that the male prisoners can converse with female prisoners, and occasional access to the rooms of the latter has been obtained. * * *

"As a rule, the prisoners have access to no books, no efforts of any kind are made for their intellectual or moral improvement, and no interest shown in their welfare. * * *

"Can it be wondered at that the universal experience is that this treatment tends to make men criminals instead of reforming them? These evils are not peculiar to our own State. They exist elsewhere, and all who have turned their thoughtful attention to the subject, whether as practical men or philanthropists, unite in the opinion that our present county-jail system is an unmitigated evil and ought to be abated."

Such is the testimony as to the condition and influence of the jails in the state of Michigan, as given after personal

examination, by gentlemen every way competent to form correct opinions.

In the report of the State Board of Charities of the state of Illinois we find the evidence that the jails in that state are equally obnoxious to unfavorable criticism. This Board in their report say:

"The prisoners, in nearly every instance, are absolutely without employment for mind or body. There are no libraries in the jails; even a Bible is ordinarily wanting; papers are rarely furnished, and no work is provided for the prisoners, much less required of them. Idleness is a fruitful source of vice; and enforced idleness has developed, and always will, the most debasing passions and habits. * *

"The efforts made at reformation of criminals in the jails of this state are unsystematic, unintelligent, fitful, and in the most of the counties wholly wanting. * * *

"There are three objects in view in all criminal legislation—*first*, the satisfaction of justice; *second*, the protection of society; *third*, the reformation of the offender.

"As to the first of these ends, vengeance is a divine prerogative. The second and third are the only ends which society has the right to seek to accomplish. But be it so. Admit for argument's sake that the public has a right to torture the criminal in its power, simply because he deserves torture. What then? Then let the law prescribe what and how he shall suffer. If he is worthy of death, hang or behead him; but do not, without color of law, kill him by inches by refusing him air to breath. If he has taken his neighbor's goods, let him by hard labor atone for the act. Let him make restitution. But do not deny him the light of day; do not compel him to be idle, for weeks and months; do not disgrace our boasted christian civilization, by forcing him to live over an open privy-vault used by a score of prisoners. But a county jail is not solely or principally a place of punishment. It is more properly a place for safe-keeping of persons awaiting trial, about one-third of whom are, upon trial, declared to be innocent. The jail is also used for the detention of the insane and of witnesses—persons not suspected of crime. That a person guiltless of crime should be forced into such a place, and there confined for weeks or months, his health destroyed, and all his finer feelings outraged, is itself a crime against humanity. Such a policy makes great criminals out of little ones."

We have testimony from Ohio showing that the common jail system in that State is similar in its developments as in other States.

The Ohio Board of State Charities, in their second annual report, in speaking of their county jails, use the following emphatic language:

"It is a startling and terrible proposition, sustained by this report (the report of their secretary), that Ohio is to-day supporting, at public expense, as base 'seminaries of crime' as are to be found in any civilized community. Children, youth, the young man, the middle aged, the old, all at the first simply accused of crime, and more or less wrongfully accused—many for their first offense, some old offenders, some debauched, cunning corrupters of men,—representatives of each of these classes are found congregated in our jails. And to perfect the wrong they are crowded often into an ill-ventilated, dirty, dark prison, where the whole being, physical, mental and moral, is soon fitted to receive all 'uncleanness with greediness.' With bad air, vile quarters and depraved associates, little can be added to hasten the perfection of the student in crime. And these schools of crime are to-day found in every county in the State, sustained under form of law, and at the expense of the public."

The Committee on Prisons, of the late Constitutional Convention of New York, in a report to that body, sum up the result of their investigations as follows:

"That there is no one of the sources of crime which is more operative in the multiplication of thieves and burglars than the common jails of the State, as at present organized."

The Committee of the Prison Association of New York, in their report for 1867, speaking of the jails of that State, say:

"They are, indeed, as now constructed and managed, nothing less than seminaries of vice and nurseries of crime."

Miss Dix, the eminent philanthropist, after an extended observation, says:

"If it were the deliberate purpose of society to establish criminals in all that is evil, and to root out the last remains of virtuous inclination, this purpose could not be more effectually accomplished than by incarceration in the county jails, as they are, with few exceptions, constructed and governed."

From the report of the Prison Association of New York for 1870, we find that but little improvement has been made in the condition of the jails of that state, although the attention

of the legislature and the people was called to the matter several years. Abraham Beale, the General Agent of the Association, in his report to the Executive Committee, says:

"That he is more than ever confirmed in the opinion that the *best side* of a prison is the outside, and that there exists but little within calculated to make men better; and this applies especially to our county jails. * * Nothing is done to elevate the moral condition of the prisoners—not a friend to visit them; not a book for their perusal; not a rebuke or admonition; not a word to the innocent; not a moral lesson given; not a sermon preached; not a prayer offered; no anxiety or solicitude expressed either by the church or the world, for the reformation and salvation of those unfortunates; hence so few reform."

John D. Guscom, M. D., in his report to the same body of his inspection of the jails of several of the counties in the state of New York, during the year 1870, says:

"They remain much the same as heretofore; and it would be a waste of time and paper to repeat details, which have been given, again and again, on former occasions. Their internal arrangements are for the most part inconvenient and unsatisfactory; old and young, novices and professional criminals, the innocent and the guilty, are generally huddled together in the day time, and imperfectly separated at night; there is but little in jails of what may be called discipline, and less of moral agencies for the benefit of their inmates; the prisoners have no regular employment, no secular instruction, no libraries, and generally, no provision is made for a due supply of their religious wants; * * such is the detail—by no means an exhaustive one—of the imperfections, defects, and objectionable features of our system of common jails."

One more brief quotation from a report of the New Prison Association—one of the highest authorities on the subject in the land:

"In the association of prisoners in our common jails the promiscuous intercourse of all classes, all ages, and to a certain extent, we are sorry to add, of both sexes, we have the great evil, the very Pandora's box of the system; the fountain head of pernicious influences, not simply to the inmates themselves, but to the whole community as well, in the midst of which the jail happens to be situated. If an institution should be established in every county of the state, with the inscription over the door "Vice and crime taught here" and the processes within corresponded to the announcement without, this committee is impressed with the convic-

tion that the work of manufacturing criminals could scarcely be more effectually done than it is by our jail system as at present organized and managed. This is strong language but it is not lightly used. There is we think, no proposition more true, than that our present jail system is deeply depraving to the prisoner, and a positive evil to the community."

Were the inmates of our jails the worst of criminals, were they in all cases persons who had been charged with the most heinous crimes, who had been fairly tried, found guilty and justly sentenced, it would be an outrage upon their manhood, a disgrace to the people of the state, and a reproach to the civilzation of the nineteenth century to confine them in such places as are many of our jails; but when we remember that the occupants of our jails are mostly persons simply charged with crime, and that too of the milder types, and that the trial often shows them to have been innocent, that sometimes they are merely witnesses, or persons sentenced for a few days or a few months for some minor offence, sometimes mere boys and girls, the outrage, the disgrace and the reproach seem a thousand fold intensified. The chief trouble seems to be inherent in our present criminal system as connected with our jails. The whole system is a relic of the barbarous ages of the past, and the great wonder is that it should have been allowed to remain so long unchallenged.

I have briefly called attention to the condition of the common jails of the country. Their real condition must be understood and appreciated before any great improvement can be made. The remedy for the evils and defects which have been pointed out, will form an appropriate subject for another paper on some future occasion.

DEPARTMENT OF NATURAL SCIENCE.

DEEP-WATER FAUNA OF LAKE MICHIGAN.

BY P. R. HOY, M. D., RACINE.

At a distance of sixteen to twenty miles off Racine the water in Lake Michigan is from fifty to seventy fathoms deep. The bottom, at these depths, is composed of an impalpable, dark-colored mud, interspersed with depressions containing quantities of partially decayed leaves intermingled with the muddy deposits. It is on these "mud flats" that the fishermen capture, in gill-nets, the largest and finest white-fish and trout.

The food of the white-fish had never been ascertained. In order to solve this problem, I secured large quantities of the stomachs of fish caught in various depths; by diluting the ingesta I was enabled to determine on what the fish subsisted. During these investigations I became deeply interested in the new forms of animal life that swarmed in the deep water—fish that never visit the shore; crustaceans, that live only in the profound depths of the lake. I discovered three species of fish, four species of small crustaceans and one mollusk—all new to science. The fish I sent to the Smithsonian Institute at Washington. They were placed in the hands of that accomplished naturalist, Prof. Theodore Gill, who described and named them.

When I sent the fish to Prof. Baird I asked him to whom I should send the crustaceans? Who was the best authority on that branch of natural history? His answer was we had in the West the very man, the best authority in America on the

crustacea, Dr. William Stimpson, Secretary of the Chicago Academy of Science. I record here this fact in justice to Prof. Stimpson and the West.

Two of the fish belong to the genus Argyrosomus, a genus proposed by Agassiz to include that section of white-fish having a projecting under jaw.

The *Argyrosomus Hoyi*, Gill, is the smallest of the white-fish so far found in any of the great lakes, it being only about eight inches in length, and weighing one-fourth of a pound. The *Mooneye*, as called by the fishermen, is an excellent pan-fish, but its small size renders its unsuitable for market. Trout devour large numbers of these little beauties, as they constitute a large share of their food. The *Mooneye* is only found in water over forty fathoms.

The black-fin, *Argyrosomus Nigripinnis*, Gill, is a large and beautiful fish, having black fins. It has never been caught in less than sixty, and does not occur abundantly in less than seventy fathoms. During the summer of 1871 there was not a single black-fin taken off Racine, as the fishermen did not go as far into the lake as they did the previous season.

The third species of fish was taken from the stomach of a trout, caught in the deepest water. It belongs to the *Cottus* family, and is closely allied to *Triglopsis Thompsonii*, Girard, if not identical. *Triglopsis Thompsonii* was taken from the stomach of a *Lota Maculosa* (by Prof. Baird) caught in Lake Ontario in 1850, since which time not a specimen has been taken, I am informed by the Professor, unless this be the same fish taken now from the trout, as before mentioned. Prof. Gill thinks it is probably an undescribed species, near *T. Thompsonii*. If this prove so on further investigation, it will be named *Triglopsis Stimpsonii*. What is peculiarly interesting about this small fish is, that it is a salt water rather than a fresh water form. Judging from the quantity of fragments belonging to this species, obtained from the stomachs of trout caught in the deep water, it must by no means be rare.

I submitted the minute crustaceans to Dr. Stimpson, who detected three species of fresh water shrimps, belonging to the genus *gammarius*, and one species of *mysis*, a marine genus, many species of which are found in the Northern Atlantic and Arctic oceans. The small shell found with the crustaceans, in the stomachs of the white-fish, proved to be an undescribed species of *pisidium*.

These discoveries were considered of sufficient importance to justify the undertaking of a dredging expedition. Professors Stimpson and Andrews, with Mr. Blatchford, of Chicago, represented the Chicago Academy of Science, while Drs. Lapham and Hoy represented the Wisconsin Academy of Arts and Letters.

On the 24th of June, 1870, we steamed into the lake, out of sight of land, and spent the entire day in *dredging* in a most enjoyable, and to science profitable, manner. We procured living specimens of those crustaceans which I had previously obtained from the stomachs of white-fish. But, with every exertion, we were not able to keep them alive above a few hours. Fitted, as they are, to sustain the great pressure of from fifty to seventy fathoms of water, when this was taken off death was the inevitable result.

I here subjoin a catalogue of all the animals thus far known to inhabit the deep water off Racine:

Salmo amethystus—Mitchel.
Coregonus sapidissimus—Agassiz.
Coregonus lattor—Agassiz.
Argyrosomus Hoyi—Gill.
Argyrosomus nigripinnis—Gill.
Triglopsis Thompsonii—Girard.
Gammarius Hoyi—Stimpson.
Gammarius brevistilus—Stimpson.
Gammarius filicornis—Stimpson.
Mysis diluvianus—Stimpson.
Pisidium abysomus—Stimpson.

Also one species of parasite leech, found fastened to white-fish, and a small white *Planaria.*

In conclusion, the occurrence of *marine* forms (*mysis* and *triglopsis*) go far to prove that Lake Michigan was once salt; had direct communication with the ocean. As it gradually became elevated above the sea it would naturally take many years to expel the salt water, especially as its greater specific gravity would cause it to sink and remain long in the lake —time sufficient for the animals to become acclimated to the changed condition of things. It is barely possible that salt springs at the bottom of the lake may have materially retarded the change; and that even now there may be brackish water in the greatest depths. This seems the more probable since the salt-bearing strata occurs in Michigan. We made an effort to solve the query, but owing to the imperfection of the apparatus I am not certain that the negative was proved.

H.

ON THE CLASSIFICATION OF PLANTS.

BY I. A. LAPHAM, LL. D.,
Milwaukee.

Animals in the hands of Cuvier and Agassiz, and minerals by Dana and others, have been well and scientifically arranged into natural divisions with their proper order of succession. But plants, especially in the higher divisions of classes and their subdivisions, still need the attention of a systematist.

It has been supposed that since De Candolle introduced into botany the idea of EXOGENS, (outside growers), and ENDOGENS, (inside growers,) the classification of plants was complete. It is proposed to show that this supposition is erroneous, and has led to incongruous results needing reformation. It may be claimed as true that, so far as regards the description of species, and their grouping into genera and families, botany is the most advanced and perfect of any of the natural sciences; but as regards the limitations of classes and orders it is the least advanced. It is only in relation to these larger divisions of the vegetable kingdom that any suggestions will be made in the present paper.

The most important of all plant-products—important to the very life and continuance of the plant is the seed, the organ in which one individual plant terminates, and another begins. It is the ultimate product, and the one towards the perfection of which all other vegetable organs and processes seem to conspire. Near the close of the growing season, the whole plant-energy is concentrated upon the seed; the seed is perfected and the plant dies.

As the grand divisions of the vegetable kingdom must rest

upon the most important characters, it is quite obvious that we must look to the character of the seed for this purpose. Less important characters will do for the minor divisions, but not for the higher.

The seed contains, as its most important—most essential part an *embryo*, consisting of the radicle, cotyledons and plumule. This is usually surrounded with a store-house of food for its future use in germination, called albumen. Two envelopes or coverings protect these more essential parts of the seed. These several parts are subject to various modifications; the cotyledons may be single, double, or many; the albumen may be stored within the body of the embryo, etc.—though thus modified they are essentially the same. Thus the seed contains, already, a little plant that only requires the proper conditions to be enlarged into an oak, a lily, or some other plant.

Fig. 1.

But seeds are not the only reproductive bodies among plants; there are others, not so familiarly known to us, called spores. They are simple cells filled with minute dots, and have the power of sending out little shoots, which grow and become new plants. All spores send forth these little tubes, almost exactly alike, apparently, and yet one will grow to be a mushroom, another a moss, and another a fern.

Fig. 2.

There are essential differences between seeds and spores; while one has buried in its substance an embryo, which is enlarged in germination into a perfect plant, the other contains no embryo; the seed always grows from a definite point, but the spore sends out its tube from any part of its surface; in the seed, the new plant has already made considerable progress; in the spore, re-production has not yet taken place. The seed, then, is a more advanced body than the spore and indicates a higher order of plants. All plants produce either seeds or spores.

Fig. 1—a seed with its embryo.
Fig. 2—a spore, magnified.

Here, then, we have the basis of our first grand division of the vegetable kingdom into two very distinct and easily recognizable parts; the one contains the spore-bearing plants (SPORIFERÆ), the other includes the seed-bearing plants (SPERMIFERÆ). This corresponds exactly with the division generally adopted, into flowerless and flowering plants. But these names are objectionable, especially for the higher orders of spore-bearers, the mosses, ferns, etc., which have organs so analogous to true flowers that we cannot say they are really flowerless. Recent botanical writers are hardly consistent in describing the inflorescence, or mode of flowering of these so-called flowerless plants. They all produce and are propagated by spores, and hence we not only avoid this absurdity but follow nature more closely by calling them spore-bearing (SPORIFEROUS) plants.

Just in proportion as we value a thing, so do we provide for its care and protection; and so in nature the seeds and spores of the higher classes of plants are provided with coverings for their protection, while those of the lower classes are left almost or quite naked. We thus have not only a basis for the next subdivision of the vegetable kingdom, but a sure indication of the relative position of these subdivisions in rank and importance.

I. The lowest class of spore-bearing plants—the Algæ, Fungi and Lichens—produce spores directly upon or within the body of the plant, without special provision for covering or inclosing them; hence these may be called GYMNOSPORÆ or naked-spore-bearing plants. The *asci* in which spores are found are mere openings or sacks, and can hardly be called capsules or spore covers. These are the lowest and most simple plants; they stand at the bottom of the scale of vegetable life.

Fig. 3.

II. The second class of plants we will call ANGIOSPORÆ, because the spores are covered or provided with little cups

Fig. 3—lichen, magnified.

with lids in which they are closely packed away. This class of the spore-bearers includes the Liverworts, Mosses, Ferns, Lycopods and Equisetacæ. They are the higher families of the Cryptogams.

Fig. 4.

III. The seed-bearing plants we may divide in the same way: first we have the GYMNOSPERMÆ, or naked seeds, in the Coniferæ, (pines, etc.,) and in the Cycadaceæ, tropical plants, but little known here.

In all these plants there are no proper seed vessels. They are, therefore, the lowest class of the seed-bearers, SPERMIFERÆ.

Fig. 5.

IV. Next and last we have the ANGIOSPERMÆ, or plants with seeds that are covered, such as the pea and most of our familiar fruits. This is the most highly organized class of plants, standing at the head of the list in all modern botanical works.

We have, then, two grand divisions and four minor divisions or classes of plants, all based upon the reproductive organs: thus

SPORIFERÆ, Spore-bearing.	*Gymnosporæ*, Naked spores.
	Angiosporæ, Covered spores.
SPERMIFERÆ, Seed-bearing.	*Gymnospermæ*, Naked seeds.
	Angiospermæ, Covered seeds.

The beauty and simplicity of this arrangement is apparent, and may be deemed a sufficient proof that it is in accordance with nature, which is always simple, methodical, and progressive; and yet it differs essentially from any heretofore adopted, in placing the Gymnosperms (conifers, etc.) below all the Angiosperms, whether of exogenous or endogenous structure.

Fig. 4—theca or capsule of a moss.

Fig. 5—scale from a pine cone showing the two naked seeds.

It remains to be seen whether this classification, so simple and logical, is sustained by the consideration of other characteristics.

Spores and Seeds—

Class 1. Has spores only.
2. Same.
3. Cotyledons indefinite in number.
4. Cotyledons definite; either one or two.

In all proper systems of classification the indefinite is deemed inferior to the definite, and hence our 3d class, the plants with naked seeds, falls below the whole of class 4.

Flowers—

These also show a regular progression through the several classes:

Class 1. Flowers obscure or none.
2. Without proper stamens and pistils.
3. Without pistils, (stamens only.)
4. With both stamens and pistils.

Leaves—

Class 1. Leaves none.
2. With the venation dichotomous.
3. Venation both dichotomous and parallel.
4. Venation parallel and netted.

Structure—

Class 1. Cellular.
2. Cellular with a few woody fibres.
3. Cellular with woody fibres; cells with discs.
4. With woody and vascular fibres.

Mode of growth—

Class 1. Irregular; no distinction of stem and leaf. *Thallogens.*
2. A regular ascending axis; growth at apex. *Acrogens.*
3. By external layers. *Exogens* (in part).
4. By both internal and external layers. *Endogens* and *Exogens*

Geological age—

Class 1. Found in the Lower Silurian age.
2. First found in the Upper Silurian.
3. First in the Devonian.
4. First in the Carboniferous.

So it will be seen that whether we regard the character of the seed, the flowers, the leaves, the structure; whether we regard the mode of growth or the relative age of the world at which each class was introduced, we equally find that, with this arrangement, there is a regular progression from the more simple to the more highly organized; and from the oldest to the most recent. It is therefore the most natural and proper classification of plants.

But to find this regular progression we have been obliged to disregard one character usually deemed of the highest importance. Plants with the exogenous mode of growth are divided and placed in two different classes. We are thus compelled, in this new classification, to consider the mode of growth or internal structure of stems as of only secondary importance.

The Gymnosperms are shown to be inferior to all the Angiosperms by their indefinite number of cotyledons; by their flowers without pistils; by their dichotomously veined leaves, which allies them with the ferns; by their want of vascular fibres in the structure of the stem; and by the earlier epoch of their creation. Hence it must be right to reduce these plants to a position below that of the palms, the lily, and the orchids.

When Cuvier found that the anatomy, the internal structure of animals indicated their relative position in the scale of animal beings, the conclusion was very natural that the same law existed with regard to plants; and hence the prominence given by De Candolle to the exogenous and the endogenous structure in his classification. But this must be regarded as one of the most unfortunate ideas ever introduced into botany; for it requires that we rank the Gymnosperms above the Monocotyledonous plants, though their affinities are thus clearly shown

to be more nearly with the Angiospores, (the Lycopods, etc.) Botanical writers generally, admit this defect in the present arrangement, and yet persist in perpetuating it; such is the disposition to follow authority without examination. The doctrine that "the king can do no wrong" is equally deleterious in botany and in politics!

If the more simple forms of plants were first created, to which were added, from time to time, those of more complicated structure; and if the arrangement of classes must correspond with that of their introduction in geologic time, we must adopt this new classification; for it is found that the Coniferæ existed in the Devonian age, while the Monocotyledons extend back only to that of the Carboniferous.

By thus removing the Gymnosperms from between the Dicotyledonous and the Monocotyledonous plants we bring these two nearly related grand divisions of the Angiosperms together; thus while we separate the Exogens, part into one class and part into another, we at the same time unite and bring together the Angiosperms, which have been unnaturally separated. By the divorce of an unnatural union we secure another, more congenial.

In the following table an attempt is made to represent, in a compact form, the ideas I have thus attempted to explain; and also to show how each class may be divided into two well characterized groups.

THE VEGETABLE KINGDOM,

Organic bodies, living and subsisting upon the Mineral Kingdom, and affording subsistence to the Animal Kingdom.

SPORIFERÆ. Plants bearing spores; no true embryos; no cotyledons.				SPERMIFERÆ. Plants bearing seeds; an embryo; one, two or more cotyledons.			
GYMNOSPORÆ, Spores naked.		ANGIOSPORÆ, Spores covered.		GYMNOSPERMÆ, Seeds naked.		ANGIOSPERMÆ, Seeds inclosed.	
Spores (without embryos).		Spores (without embryos).		Seeds with embryos; cotyledons indefinite, usually more than two.		Seeds with embryos; cotyledons definite, either one or two.	
Flowers, obscure, or none.		Flowers, without proper stamens and pistils.		Flowers with stamens only, (no ovary, style, or stigma), the pollen falling directly upon the ovules.		Flowers complete, having both stamens and pistils.	
Leaves none; (stem and leaves confounded.)		Leaves distinct from the stem; venation dichotomous.		Leaves with the venation Dichotomous or Parallel. Ex. Salsburia. Ex. Zamia.		Leaves with the venation Parallel, or netted.	
Structure cellular.		Structure cellular, or cellular with a few woody fibers.		Structure cellular, with woody (no vascular) fibres; cells with circular discs.		Structure cellular, with fibres both Woody and Vascular.	
Growth irregular; no axis; no stomata or breathing pores. Thallogens.		Growth at apex of an ascending axis; stomata present. Acrogens.		Growth at the apex (no axillary buds) and external. Exogens.		Growth from terminal or axillary buds, either internal or external. Endogens. Exogens.	
First appears in the Lower Silurian Rocks.		First appears in the Upper Silurian.		First appears in the Devonian.		First appears in the Carboniferous—Cretaceous.	
Aquatic. Marine and fresh water Algæ.	Aerial. Fungi and Lichens.	Cellular. Liverworts and Mosses.	With Woody and vascular fibre. Ferns, Lycopods, etc.	Seeds at the middle of the scales. Coniferæ.	Seeds at the margin of the scales. Cycadaceæ.	With but one cotyledon. Monocotyledons.	With two cotyledons. Dicotyledons.

INSECTS INJURIOUS TO AGRICULTURE.

APHIDES, (PLANT LICE.)

BY P. R. HOY, M. D., *Racine.*

Entomology, the history of insects, their metamorphoses, habits, relation to plants, etc., is a branch of natural history which has peculiar claims on the agriculturist. In view of the millions of dollars annually lost to the state by the depredations of insects, it becomes an interesting problem how to distinguish in all stages of growth, our insect friends from our insect foes, that we may be better fitted to cherish the one and destroy the other.

When will the representatives of the people understand that Wisconsin can ill afford to dispense with the invaluable services of a state entomologist? We have a host of insects, peculiarly destructive, waiting for careful study, the better to enable us to counteract their evil work. Not the least of the advantages to be derived from the labors of an active, enthusiastic state entomologist, is the education of the farmers by personal contact; thus teaching them how to distinguish the various insects by which they are surrounded, in their different stages, so that this practical knowledge may be of value to themselves and to their neighbors.

PLANT LICE.—Small, green, brown, black or white, soft bodied insects, with or without wings; crowding together on leaves, stems, bark or roots of various trees and herbs. Many species are covered with a white cottony substance, hence called Woolly Aphides. The number of species is very large, not a genus of plants that has not its peculiar species; many, more than one. The apple alone, according to Fitch, has not less

than five species of plant lice. One of the most common infests the tender leaves of the apple, the *Aphis Mali*, Fab. This species is green, egg-shaped, one-tenth of an inch in length; it is either with or without wings. They are provided with two spurs, or nectaries, which originate near the center of the body. These nectaries secrete a fluid as sweet as honey. So astonishingly prolific is this insect, that the increase of one single egg, it has been estimated, in seven generations, would be 729 *millions!* If it were not for the good offices of those animals which prey upon plant lice, every thing green on the face of the globe, would, in a short time, be covered with these voracious insects. They crowd as thick as they can stand, their long suckers inserted into the succulent young shoots and leaves, pumping up the juice. If disturbed, they jerk up their bodies in a comical way and emit, from their nectaries, a shower of honey, apparently to bribe the intruder with this sweet fluid. Not unfrequently they kick up their hind feet in unison, impelled by an excess of animal spirits, from very joy of existence.

The history of this species is extremely interesting. In the spring, as soon as the young leaves appear, the eggs hid away in the crevices of the bark, hatch. The young creep to the extremity of the branch and fasten on the young shoots. In a few days the louse is fully grown. All the eggs laid in autumn produce wingless females, and these females do not lay eggs, but bring forth *living* young which are also females.

The young when first born are milk white, but change in a few hours to the color of the parent. In a very few days these young lice produce living progeny also. And so on for from fifteen to twenty generations, each individual louse producing from five to ten each day, all without the presence of a single male; for in fact there is not a male in existence! A few winged females appear occasionally, which take wing and plant new colonies. Thus goes on this remarkable form of reproduction till fall, when there appears a brood of winged

males and females which pair, in the usual manner. The result of this union is not living aphides, but eggs, which in the month of October the females deposit in the crevices and cracks on the bark of apple trees. Soon after this the lice all perish. The eggs remain securely hid away during winter, to be called, by the warm days of another spring, into life, again to repeat this wonderful phenomenon.

APHIS PROTECTORS.—Ants are almost always seen busily running up and down trees and plants infested by the aphis. These ants take charge of the lice, guard them from harm with zealous care; for which good services they are amply paid in honey, by the plant lice. The ants approach the lice, and if there is not an accumulated supply, they touch them with their antennæ by way of reminding them of their wants; at once the lice respond with a drop of their sweet fluid. For this reason plant lice are humorously called *Ant Cows.* It is a well known fact, that colonies of aphides attended by ants thrive better and are more prolific than those which the ants have not found.

APHIS ENEMIES.—Now for the Aphis foes, and consequently our friends. We place first on the roll of honor, the larvæ of the Lace-wing flies, which are called Plant Lice Lions, a name well deserved. Lace-wings belong to the family *Hemerobdia*, order *Neuroptera.* There are many species of Lace-wings; they are mostly not over half an inch in length; color, pale green, or yellowish brown, with conspicuously prominent golden eyes, for which reason they are sometimes called Golden Eyes. They are provided with four large wings, which expand a little over one inch. These wings are netted in a beautiful manner, resembling the finest lace, hence the name. These flies may be met with during the entire summer, in the vicinity of trees infested with lice. They are nocturnal in their habits.

The manner in which the female Lace-wing deposits her

eggs challenges our admiration at the beautiful adaptation of means to the accomplishment of important ends. Nature has furnished this insect with a fluid analogous to that of the spider for spinning her web. When ready to deposit an egg, this insect touches the end of her body to a branch or leaf, and then elevates the abdomen, drawing out a pure white thread, half an inch in length, which hardens instantly, on the summit of which she fixes an egg. This being repeated, from 10 to 20 eggs are thus placed on slender threads. The eggs when first deposited are pale green, becoming opaque before hatching. Now the object of thus placing the eggs on these hairs is evident. Were they placed in reach the first larva that escaped from an egg would devour the remainder. So nature has well guarded the continuance of the species.

The larvæ of the various species of Lace-wings differ considerably in color. They are mostly of a reddish brown, lighter on the sides, with a dark line down the back. The body is long, wrinkled, short hairs projecting from each segment; has six legs, and is armed with a pair of formidable, sickle shaped jaws, which project conspicuously in front. Thus armed these lions hurry about in one continual state of activity day and night in quest of plant lice, their legitimate prey. They seize the lice with their tongs, and elevate them, till they have sucked every particle of substance from the bodies, then giving the skins a toss, resume their search for more victims. It is astonishing how many lice are destroyed by a single aphis-lion.

Having attained its growth, the lion make the last meal an excessive one, remains torpid for a day or two, then spins a circular cocoon in which the insect is entombed during the winter. The first warm day of spring calls them out. So opening a small door, in this temporary grave, emerges a beautiful Lady Lace-wing, dressed up in the most extravagant finery.

LADY BIRDS.—Family *Coccinellidæ*, order *Coleoptera*, small,

nearly round beetles, ornamented mostly with spots of various colors on the elytra.

There are about one hundred species described as belonging to the United States. In my collection alone there are no less than twenty species, obtained near Racine. So Wisconsin is not deficient in these valuable insects. These beetles deposit their eggs in clusters on the under side of leaves on various plants. Their eggs are of a shining, golden yellow, resembling those of the Colorado potato beetle. In a few days they hatch out six legged, dark colored, long bodied larvæ. Their jaws are short, but sufficiently long, however, to be of good service in killing aphides.

These larvæ are nearly, if not quite, equal to the *aphis lions* in destroying plant lice. Dr. Fitch, New York state entomologist, so faithfully describes the habits of this *plant lice wolf*, as it might appropriately be named, that I adopt his language. When first hatched, "it walks about with much animation, and coming to a plant louse, much larger than itself it may be, the little hero, though only a few minutes old, boldly seizes the louse, which, like a cowardly poltroon, makes no resistance except trying to pull himself away. But the little assailant hangs lustily to him, preventing his advancing a single step further, and using his anterior legs as arms, he commonly raises the louse off from the leaf and leisurely devours his body, leaving only the empty skin remaining. As he grows, the sides, and in some species the whole surface, becomes diversified with bright red and yellow spots with rows of tubercles or elevated points. He is a most active voracious little creature, running briskly over the limbs and leaves in search of his prey, and consuming hundreds of aphides. He grows to about a quarter of an inch in length in the course of two or three weeks; he then fixes himself by his tail to a leaf, or the limb or trunk of a tree, and hanging with his head downwards the skin cracks open along the middle of his back, and the smooth back of the pupa protrudes partly out of the prickly skin of

the larva, and thus remains, the old larva skin continuing to cover the pupa on each side and beneath. The insect remains dormant in its pupa state about a fortnight, when its hard exterior shell cracks open, and from it crawls a small shining beetle nearly the shape of a half pea, though often much smaller than this."

THE AGENTS WITHIN OUR CONTROL FOR DESTROYING PLANT LICE.—The smoke of tobacco, when it is possible to confine it for a time, is undoubtedly one of the most efficient remedies for extinguishing these pests. In green houses, graperies, conservatories, etc., the smoke is always potent. Small out-door plants can be covered with boxes, barrels, or even umbrellas, or anything that will form a temporary cover, will answer, and insure the destruction of the aphides with tobacco smoke. But on large trees, and vines, smoking is not practicable. The next best thing is a thorough drenching with strong tobacco water; say one-fourth of a pound of tobacco to one gallon of boiling water. Soap suds has been used with good results. A strong decoction of quassia wood has also been attended with some benefit. But of all remedies for out-door trees and vines, I prefer collecting, with a net, by sweeping bushes and coarse weeds, the several larvæ described in this article—*aphis-lions* and *aphis-wolves.*

Several years ago a fine balsam fir, fifteen feet in height, standing in my grounds, became overrun with a species of woolly aphis, which deformed the leaves, and there was danger of the tree being destroyed by them. With a net I collected a brave lot of the larvæ of lady birds, and placed them on the lousy tree; at the same time I noticed several packets of lace-wing eggs. The combined labors of these soon destroyed every single louse. The tree, now sixty feet in height, has never, to my knowledge, had an aphis on it since.

Last year my out-door grapes became badly infested with lice; I secured many aphis-wolves and aphis-lions, which I

transferred to the vines; in less than two weeks the grapes were entirely free of these pests, without resorting to other means.

I know of many incidents illustrating the woful ignorance of persons otherwise intelligent, who were waging an exterminating war against insects and birds, at the very time they were engaged in the good work of devouring noxious insects.

CONIFERÆ OF THE ROCKY MOUNTAINS.

BY J. G. KNAPP, ESQ., MADISON.

Mr. President and Gentlemen:—I have the pleasure of presenting you some seeds—nuts you may call them—which as you perceive are somewhat irregular in form, one-half inch in length, and one-third in thickness. Generally they are of a pale brown color. The testa, outer shell, of a very peculiar texture, is neither woody nor leathery, but a mixture of both, and about .02 of an inch in thickness. It is easily broken in fragmentary pieces, though in germination it parts in two equal valves. When this testa is removed, the inner integument of a slight drab color, and gauze-like texture is exposed. Beneath this is formed the kernel. The body is of a pearly whiteness, cylindrical, two and a half times as long as thick, with a light brown apex. On cutting this through the centre longitudinally, the cylindrical embryo or embryos, are seen occupying nearly the entire length of the albumen, and one-third the face of the hemi-cylinder. The cotyledons vary from three to twelve, and are arranged around and cover the apex of a central shaft, the radicle occupying the opposite extremity. This nut is therefore the fruit of some acrogens, or is nearly allied to such plants. The whole of this kernel is gorged with a remarkably sweet oil, and is perhaps the most delicately flavored of any nut in North America, if not in the world. When the inner integument is eaten with the kernel, it imparts to it a balsamic flavor.

These are the nuts of a pine tree, although there is no trace of the fragile wing with which the nutlets of the coniferæ are

usually furnished. Such a wing in this case, unless it were very large, would answer but a poor purpose in floating these nuts from the tree. These nuts came from New Mexico, and are the produce of the *pinus edulis*, or the *piñon* of the Mexican. I shall ask you to receive and preserve these in your cabinet.

I think I see in this kernel and embryo another evidence of the necessity of revising the botanical classification of our plants, and of separating the coniferæ from the dicotyledonous plants, since they do not agree with the condition, two in the number of cotyledons; or from the exogenous trees, where they disagree in the form of the fibre of the wood; and arranging them in a class by themselves, between the exogens and acrogens.

The tree on which these nuts grow is botanically named from the edible nuts; but one is at loss to know why the Mexican has called it the piñon, large or big pine, unless we are to suppose he has transferred the large or big nut of this pine [pineo] to the tree itself. It is usually a small tree, short-bodied, with numerous crooked branches, and a dense foliage. The wood is very hard and full of pitch, compact and brittle, and when dry is equal to the best of hickory for fuel.

Observers must have discovered that many of the evergreens in cultivation in this region, are failing for some cause not apparent to everybody. I attribute much of this failure to a want of sufficient moisture in the atmosphere. The native habitat of our cultivated coniferæ is in regions of great moisture, where the mosses abound. The climate here is different; and as our fruit-growers have been taught lessons in the expensive school of experience, so the grower of evergreens must expect to pay dearly for knowledge, when he seeks to transplant the trees of damp Europe and wooded America, to the dry regions of Wisconsin, and its sister states. We are not yet prepared, nor need we ever be, to give up the idea of growing evergreens; but it becomes the thoughtful inquirer,

in seeking to remedy the difficulties of rearing the evergreens now under cultivation, to look toward the dry cold mountain region on our west, and see if he cannot there find trees more suitable for his wants—trees that can endure the great extremes of heat, cold and droughts of this climate. This consideration induces me to describe these evergreens of the Rocky Mountains with a little more minuteness.

The *Pinus Edulis* is first seen near the foot hills of the mountains, on rocky points, and ridges, and in the out-lying hills, where it can receive but a scant supply of moisture. Grain in its neighborhood is only grown by irrigation. Here the summers are only long enough to ripen beans, and the smallest, and earliest variety of corn. The best trees are found in regions too elevated to produce any cultivated crop. It avoids the beds of the streams, and is seldom found in the bottoms of the valleys, where water from melting snows or rains may run. On the high table lands, ridges, and steep rocky mountain sides, it takes its strongest hold, and flourishes best. The leaves are in pairs, two inches long, dark green, coarse and ridged, and are persistent for two or more years. The tree gives a dense shade, and makes an excellent wind breaker. It is of too slow growth for general use, as an ornamental or forest tree; but on hard, rocky, dry ridges, and at the brow of steep table lands, it would thrive well. When at the end a hundred years, the tree has reached thirty or forty feet in height, and as many in the diameter of its rounded top, it possesses great beauty, and gives its biennial crop of nuts, and would then be greatly esteemed. It would never suffer from the droughts of summer, or be likely to perish from the cold, or winds of winter as it thrives to the very highest limit of the pines, and nearly to the line of dayly frosts.

Pinus Englemani, Engleman's pine is most deserving of attention. This is also found in the foot hills and out-lying mountains, but it is within, and high up the steep and precipitous snow-capped ranges, where it grows in greatest per-

fection. From a resemblance in the color of bark, and the general configuration of the tree, when seen at a distance to the *pinus resinosa*, it has been named by the immigrants from the eastern states, yellow and pitch pine. The trees grow tall and straight, with smooth stems, and produce a yellowish wood not unlike the wood of the *p. Resinosa.* Though the wood is hard, the tree has but little sap wood, and in most trees it is tolerably clear of pitch. When sawed the timber is applied to all purposes where white pine is used by us, and it may be reckoned as a good building material. The cones are about the size of the pitch pine of the south, three inches by two. The nutlets are armed with a wing an inch long, that floats them to a great distance from the parent tree. The leaves are short, dark green throughout the year, grow in pairs, and are often six inches long. It is a rapidly growing tree, and more ornamental than the Austrian, or the red pine. Thousands of these pines have been peeled by the Indians in times of famine with them, for the sake of the cambrium, which is sweet and nuritious, and used by them for food. In this respect it seems allied to the *pinus Lamberti*, sugar pine of California. This species has been the great source from which the ties, bridge and other timber for the Pacific railroad have been obtained.

Pinus flexilis is the white pine of the Rocky mountains. In contour it resembles the white pine of the northern states, *pinus strobus.* The dark green leaves grow in fives, and are six inches in length, fine, and flexile, hence its name. The bark of old trees is dark, and deeply furrowed. The cones are beautifully formed, four inches long and three in their greatest diameter; seeds are large as peas, sweet, oily and edible. The wood is white, but the tree produces so much sap wood, that it is of less value than the *pinus Engelmani*, for building timber, and is as hard, hence it is not often sawed into timber. The tree is a large one, often reaching one hundred feet in height, with limbs starting out at about twenty feet from the ground.

It grows in the same dry lands as the other pines of the region, and reaches from the foot-hills to the line of daily frosts. This would make a highly ornamental tree where a dark shade was desired, and its long flexile leaves, and large cones give it great beauty when near at hand, and its conical formed top and dark green foliage make it a graceful feature in the landscape. It would make an excellent shelter as a wind breaker to protect buildings, crops and animals, from the effects of the wind.

Abies Douglassi, Douglas spruce, is a tall straight tree where it grows in thickets, or has a fair supply of water, as in the cañons of the mountains. In dry and open grounds, it holds its long horizontal limbs near the ground, and with these forms a perfect conical top, with a diameter nearly equal to its altitude. The foliage is dense and dark green. The leaves are one and one-half inches long, growing in two ranks as a slender spray, much like the Hemlock, *Abies Canadense*. The bark is thicker and rougher than the hemlock, and contains a larger per centage of tannin. The cones are cylindrical, three inches long and three-fourths in diameter, and being colored during the first year are highly ornamental. The timber resembles the other spruces, and is strong and elastic; a good building material but not as durable as the pines. I know of no spruce that would be as valuable an acquisition to our ornamental trees and tree belts, as this would be, especially for dry situations. The wood burns with great heat when dry, but crackles badly, in an open fire. The long periods of drought in its native habitat do not affect it; and it flourishes above the pines; thus proving incontestibly its hardy character. We may therefore safely conclude that the Douglas spruce, would thrive, where all the other species of the family would fail from the effects of drought and cold.

Abies Nea Mexicana (?) Rocky Mountain fir, so I have venventured to name this beautiful species. The leaves are twice the length of the *Abies balsamea*, and the cones bear the same increased proportions, being often two inches long. I have

ventured to give it the specific name of *New Mexican*, since I do not find it described by any of our botanists, and when the spray and leaves were shown to Torrey in 1857, he doubted its identity with the *balsamea*, but retained that name on the authority of Bigelow. This tree is associated with Douglas spruce, in its growth, and is in all respects the most beautiful of the fir tribe. I first observed it on the 19th of Sept., 1861, near the summit of the *Sangre de Cristo* pass in Colorado, at an elevation of about 11,000 feet above the level of the sea, and thus wrote of it the time: "I passed through the yellow pines, (*Pinus Englemani*), and turning a sharp angle in the road, saw such a balsam tree as would have been the making of a Wisconsin nurseryman, or the pride of the most ornamental park in an eastern city. Its leaves were twice as long and three times as dense as any tree of the family I have ever seen. A little further up all of the trees were of this same beautiful species. Another half mile and the firs gave way to spruces, (*Douglassi*) of equally brilliant foliage." The timber of this fir is like the whole tribe, of little value, except as fuel; and even in the dry climate where it grows, is durable only under cover.

Four species of the juniper grow among these pines and spruces, which show great ability to endure the greatest extremes of heat, cold, droughts and severe winds. These are found on rocky points furthest out on the dry, windy plains, of all trees. Though dwarfed and stunted, they sometimes attain a diameter of two feet; but commonly they produce clumps of a dozen or more trees springing from a common root, which spread out laterally as far as high, forming a hemisphere of yellowish-green foliage, and pale blue berries. All are densely leaved, and yield an abundance of berry-like cones, which are sweet and greedily devoured by the bears and birds in winter. Hunters and Indians have been known to subsist upon these cones, for several days at a time. At least two valuable species might be selected from these junipers, well

adapted for wind breakers, if not for live hedges on dry, hard lands.

Juniperus pachyphylæa, thick bark cedar, is the best species of the red cedar I ever met with. I found this tree growing in the spurs of the White mountains of New Mexico, at an elevation of about 10,000 feet. Could it be introduced, it would be not only a decided curiosity, but a worthy acquisition to our list of evergreens. The coriaceous bark is cracked and seamed into cubical forms of two inches. The fibrous exfoliation of the other junipers is entirely wanting in this tree. The trees were growing among the Engleman pines, with smooth straight trunks, often thirty feet to a limb, clear of knots and three feet thick. The wood is close and compact, of a rich mahogany color, otherwise it resembles the wood of our red cedar, *Juniperus Virginiana*. From its habitat, where I saw it, I should think it would thrive in Wisconsin.

REPORT ON THE GEOLOGY OF THE REGION ABOUT DEVIL'S LAKE.

BY PROFESSOR JAMES H. EATON, A. M.,
Of Beloit College.

TOPOGRAPHY.—The formation of Sauk county is the Potsdam sandstone. (Potsdam epoch of the N. Y. Survey.) It lies nearly horizontal, with a gentle dip to the southeast. The higher elevations, especially in the southern part of the county, are capped with conformable layers of the lower magnesian limestone. (Calcareous epoch of the N. Y. surveys.) Running east and west through the center of the county are two parallel ridges, with an average elevation of 400 to 500 feet, and a base of two to four miles. The distance between them is three to four miles. The Baraboo river runs in this valley and empties east into the Wisconsin. A north and south valley cuts half way through the eastern end of the southern ridge, and then trends east towards the valley of the Wisconsin. In the north end of this valley lies Devil's Lake.

LITHOLOGY OF THE RIDGES.—They are a compact, crystaline sandstone, without cement, or *quartzite*. The predominant colors are pink and red, often banded with straight or contorted parallel lines of lighter and darker colors. In some places the rock is an homogeneous white quartz, with distinct and well formed crystals.

ORIGIN OF THE QUARTZITE.—Both the nature of the rock and its position give evidence that it is metamorphic Potsdam sandstone. The rock presents all gradations from the simple sandstone to the perfectly crystallized quartz. The Potsdam

sandstone consists of small rounded grains of quartz, and is very loosely cemented. It can easily be crumbled with the fingers. Hand pieces of the quartzite may be obtained in all stages from this friable sandstone to that where the grains are apparent and the rock is less friable, to that where the homogeneousness is here nearly approached but the small grains can still be seen, and finally to the perfect homogeneous quartz. No sharp geographical line of demarcation between the sandstone and quartzite, and no gradation in any direction was observed.

The homogeneousness of the colored quartzite is not as perfect as it appears. Whenever a surface has been subjected to the weather, the small grains come to view again.

The bandings of the quartzite are very similar to those in the undisturbed sandstone. These bands sometimes consist of layers of fine grains of sand.

Some of the great blocks of quartzite, which have fallen down the sides of the valley are most beautifully covered with regular ripple marks. They must have been first made in the moving sands.

The layers are nearly as perfect as in the sandstone, and have a dip equal to the inclination of the ridges. The dip on either side can be seen best from the opposite side. The anticlinal ridge on the east side of the lake is removed by the valley, which trends to the east, and on the west by another valley, which comes down to the lake. Vertical joints also lead to the conclusion that the ridge has been formed by the upheaval of the horizontal layers of sandstone. The layers were not traced north and south to determine whether they are continuous horizontally.

How was the Sandstone Changed?—Both the nature of the rock and its position forbid the idea of aqueous fusion or *active* volcanic agency. The change must have taken place by the purely wet way of partial solution and crystallization, or

by a low degree of heat, working for a long series of years through the moisture in the sandstone, probably aided by the pressure which lifted the ridges. If the latter, the change and elevation of the rock took place at the same time, and both effects were produced with extreme slowness.

WHEN WAS THE RIDGE RAISED?—Before the glacial epoch. Wm. H. Canfield, Esq., of Baraboo, has found abundant proofs of the movement of glaciers over the rock since it has been metamorphosed. In many places on the elevated portions smoothly polished surfaces of quartz of great extent have been exposed by removing the soil. Before the glacial epoch, there seem to be no data for fixing the time of the elevating and metamorphic action. There has therefore been ample time for metamorphic action of the most extreme slowness.

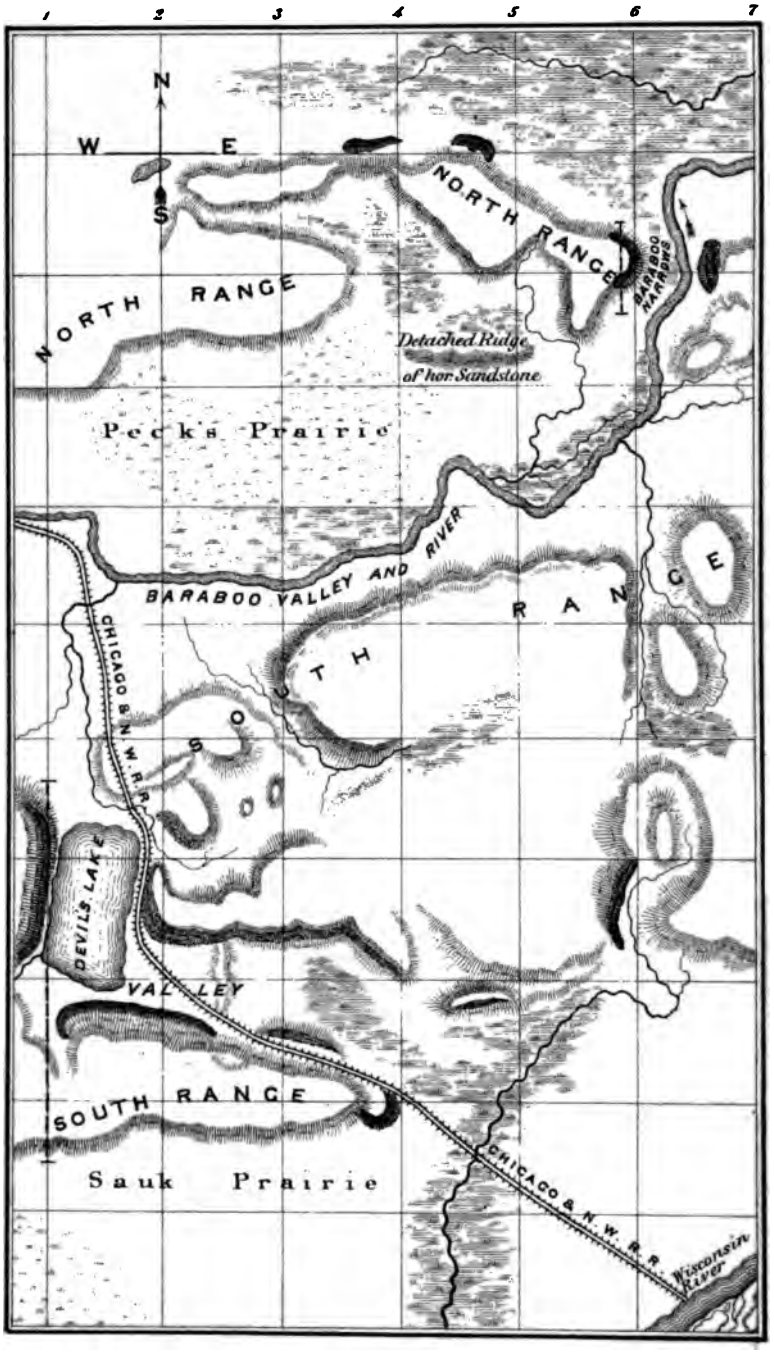
WHERE AND HOW WAS THE VALLEY OF DEVIL'S LAKE FORMED?—At a previous meeting Dr. Lapham, Secretary of the Academy, advanced in a paper the view, that Baraboo river once ran through this valley on its way to the Wisconsin, and was turned from its former course into its present one by glacial drift. If this view is correct, as the facts seem to warrant, this valley may have been made at any time from the Lower Silurian up to the glacial period. It is not necessary to introduce any great convulsion. The regularity of the layers would forbid any sudden and violent upheaval and cracking of the rock. During the slow process of upheaval, a greater extent than the others, perhaps of nearly the present width of the valley, may have been made. The slowly acting agencies of the atmosphere and of water can have widened the fissure and thrown down the great mass of debris which lies on the south of the valley. The valley is about half a mile wide. The sides slope up from 200 to 300 feet, as steep as the large blocks will lie upon each other, and the remaining height is a perpendicular wall cut by vertical fissures into most fantastic shapes, with natural fortifications and castles,

turrets and towers, making one of the most charming bits of landscape in our state.

CHANGE IN COURSE AND BED OF BARABOO RIVER.—A word in evidence that the Baraboo river formerly ran through the valley and was turned aside by the glacier drift. The surface of the lake is thirty feet above the court house at Baraboo, and one hundred and sixty feet above the Wisconsin river to the south. (These figures are Mr. Canfield's.) The lake is more than thirty feet deep and has a bottom of sand. There is therefore a sufficient descent. The valley is a natural course for the river, and running water would have given it some of the features of its present form. In the valley, both north and south of the lake, there is an abundance of drift. In a few hours a large variety of northern rocks was collected, granite, syenite and Lake Superior rocks. They, with sand, have filled up a deeper valley to such a height that the river finds a new course to the Wisconsin.

There is another point of great interest in this region, which does not appear to be easy of solution. On the top of the ridge and in lines running north and south are conglomerated boulders. These are local and do not extend far to the south of the southern ridge. They consist of rounded, water-worn pebbles, and large boulders of quartzite imbedded in a friable sandstone. Some of these conglomerated boulders weigh many tons. They are evidently deposited at a very little distance from the place of their origin. Evidently, in this immediate neighborhood, pieces of quartzite have been for a long time subjected to running water, and have found themselves in a bed of sand, which has been hardened, and some moving cause has carried them into their present positions. The place and time and agencies which have produced these effects, demand a more careful and close study, such as it is the object of the Academy to encourage. There are also signs of a sec-

ondary metamorphic action in some of the quartzite. A number of specimens were obtained which were homogeneous, but contained large numbers of rounded pebbles, of the same quartzite or of white quartz, firmly imbedded in them.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NORTH RANGE
NORTH RANGE
BARABOO RAPIDS
Detached Ridge of Iron Sandstone
Peck's Prairie
BARABOO VALLEY AND RIVER
SOUTH RANGE
CHICAGO & N. W. R.R.
DEVIL'S LAKE
VALLEY
SOUTH RANGE
Sauk Prairie
CHICAGO & N. W. R.R.
Wisconsin River

THE AGE OF THE QUARTZITES, SCHISTS AND CONGLOMERATES OF SAUK CO,, WIS.*

BY ROLAND IRVING, E. M.
Professor of Geology, Mining and Metallurgy, at the University of Wisconsin.

Through the central portion of the county of Sauk, Wisconsin, run two ranges of hills or ridges, having an east and west trend, and a height varying from a mere rise above the general prairie to an altitude of five hundred feet. The width from north to south never exceeds three or four miles, and in places is much less than one mile. The total lengths from east to west, or rather, the exact points at which the peculiar rocks which make up the ridges give place to the ordinary country rock, are not as yet accurately known. These lengths, however, seem to be from fifteen to twenty miles.

The rock material of the ridges is mainly a hard dark-colored quartzite; with this in some places are siliceous and talco-siliceous schists, and two or three kinds of conglomerate. The dip of the strata, which, though in some places obscure, is in others very marked—and can *everywhere* be determined by careful observation—is *uniformly* toward the north. The angle varies from 20 deg. to 25 deg. in the south range, to 75 deg. to 80 deg. in the north.

The occurrence of these bold ridges in the midst of a prairie country, together with the marked contrast between their upturned and metamorphosed layers and the entirely undisturbed strata of the Potsdam and Calciferous epochs, which for miles around form the country rock, has caused much speculation and discussion. From time to time, during the past twenty

* This paper has already been published, with some slight differences, in the American Journal of Science and Art for February, 1872.

years, brief notices have appeared in various journals and reports, but no careful investigation of the localities in question seems ever to have been attempted. In most of these notices, or rather in most of those that are not absurdly inaccurate in their statements and wild in their ideas, the main point under discussion has been the relative age of the metamorphic strata. Do they, or do they not, antedate the Potsdam period? Are they the results of local metamorphism on the Potsdam sandstones, or are they the remnants of pre-existing rocks? The advocates of the former theory have had the last word in the discussion.

The facts recorded in the present article are the results of a series of visits made to the localities by the writer, during the months of September, October and November of this year (1871,) and they will, I think, be seen to prove beyond all doubt or cavil, that the quartzites and schists antedate entirely the Potsdam epoch, i. e., are either Huronian or Laurentian in age.

Of all of the notices mentioned, none are more than brief mentions and only a few seem to have any value at all. Dr. Shummard, in Owen's report on Wisconsin, Iowa and Minnesota, makes the first mention of the quartzite. He gives no opinion. Dr. James G. Perceval, in the report of progress of the Wisconsin survey for 1856, refers again to the quartzites, calling them merely "metamorphic sandstones," but intimating that they result from a change on the Potsdam sandstones. Mr. James Hall, in his report of progress to the Governor of Wisconsin for 1860, gives by far the most accurate description I have been able to find. He refers the quartzites unhesitatingly to the Huronian—but gives no proofs whatever. His pamphlet did not fall into my hands until after my own investigations were entirely completed. In the first volume of his final report, Mr. Hall again mentions the quartzites, but still more briefly, expressing the same opinion as before, and still giving no proofs. In 1864 there appeared in the American Journal of

Science and Art (II, vol. XXXVII, p. 226) an article by Mr. Alexander Winchell of Michigan, in which he describes, among others, some fossils from the conglomerates overlying the quartzites; and upon them bases his claim that the quartzites are a downward continuation of the Potsdam sandstones. He himself never visited the localities. Finally, Mr. James H. Eaton of Beloit College, in a paper read before the Wisconsin Academy of Science, in February, 1871, expresses the same opinion though on somewhat different grounds. The foregoing list includes everything of any value that has been published on the subject.

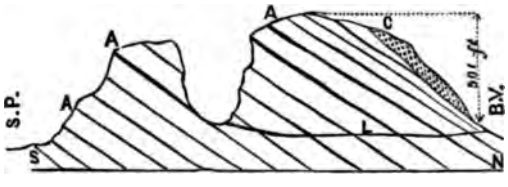
The accompanying map includes those portions of the two ridges where most of my observations have been made.

I. The South Range, to which my attention was first directed, presents, on approaching it from Sauk Prairie on the south, a bold, and, in places, precipitous rise from the plain of from 350–450 feet. The northern side of this ridge has however, in all places as yet studied, a much more gradual slope down to the valley of the Baraboo river, this slope being in many places determined by the northward dip. Running entirely through this ridge is a deeply cut valley, which has at first for about two miles, a direction slightly north of west, and then turns due north quite abruptly. This northern end holds the Devil's Lake, which entirely fills the valley from side to side. Throughout its whole length the sides of this cleft are precipitous masses of quartzite rising everywhere more than four hundred feet above the bottom, and reaching at the lake an altitude of 501 feet above its level, and of 1,474 feet above the sea. The bottom of the valley is covered with a heavy mass of Drift material, and the lake is held in its position by low Drift hills at its northern and southeastern extremities. The bottom of the lake itself seems to be in a Drift sand, and is over most of its area about thirty feet below the surface of the water. The lake has no outlet; but draining as it does a very small amount of surface, the extraordinary evaporation

caused by reflection from the cliffs above, together with the high winds of Wisconsin, is quite sufficient to account for its maintenance of level; whilst the character of the surrounding rock shows readily the reason for its not becoming saline.

The great exposures of cliff at this locality, and the deep rock cuttings on the newly-opened railroad, afford most excellent opportunities for study. The change of direction, too, of the valley, gives facilities for approaching the rocks from different sides, not elsewhere easily obtainable.

The rock here is mainly a hard, dark-colored, very compact quartzite, though the colors vary from a very light grey in places to deep brownish-red. The bedding joints of the quartzite are in some places rather obscure, but the railroad cuttings have so far exposed them, that with a little care I was able readily to ascertain the dip. This on both sides, and throughout the whole length, of the valley, is uniformly about 20 to 25 degrees a little west of north. Some of the writers mentioned, and notably Winchell, have described this valley as corresponding to an old anticlinal axis, but the uniform dip of the strata throughout its length proves, of course, that this is not the case.



SECTION 1.—North and south through the south range on section line 1 of map. A, quartzites; A', quartzites with some schists; C, conglomerate; S. P., Sauk Prairie; B. V., Baraboo Valley; L, level of lake.

The quartzite, although often looking massive, shows in many places, on weathered surfaces, the lamination and cross-lamination of more modern sandstones. Many of the fallen masses show, too, on exposed surfaces of lamination, the most distinct ripple markings I have ever seen. On the shallow sandy bottom at the north end of the lake below, may be found their very counterparts. Between the beds of quartzite, in

many places, are thin layers of a schist principally siliceous, but having always some talcose material. These correspond apparently to the clayey or shaly layers between the beds of sand now represented by the quartzite. In some places these layers seem to be merely a thinly laminated quartzite, with talcose films covering the laminæ; in others, the talcose material pervades and gives character to the whole mass, the siliceous material, however, always being present.

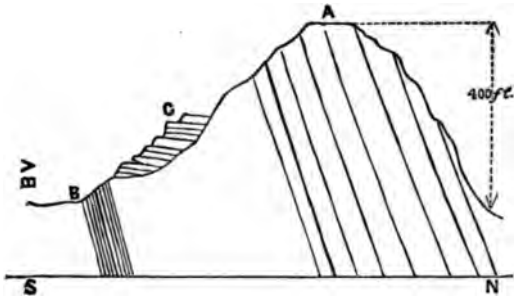
The most remarkable feature of this locality is, however, the very striking system of vertical joints which everywhere intersect the quartzite. The bearings of these joints, taken in some fifty or sixty different localities, I found to be uniformly N.E. and S.W. and S.E. and N.W., the variations in a few places being evidently due to local displacement. On the cliff sides, and more especially about the lake, these joints, together with the bedding joints, have so cut the rock into separate blocks, that these have from time to time been thrown down the bluff by frost and atmospheric agencies in huge rectangular masses, weighing by calculation from seventy-five to two hundred tons apiece.

In many places along the north flank of this ridge and lying always above the quartzite, are outcrops of a conglomerate, containing pebbles unmistakably from the quartzite below, always rounded, and in size varying from a few lines to four or five inches in diameter. In some few places there seems to be a second conglomerate in which the sandy cement itself appears altered to a quartzite. This is a point, however, deserving of further investigation. There are also places where distinct layers of coarse and fine conglomerate occur, the latter always above and graduating into a simple sandstone.

In this conglomerate are found in one locality just northeast of the lake, the Potsdam fossils described by Mr. Winchell in the article referred to, viz.: *Scolithus linearis* Hall, *Orthis Barabuensis* Hall, *Delphinocephalus Minnesotensis* Owen, etc. I have examined a collection of these fossils from the above locality,

in the possession of Dr. Lapham, of Milwaukee, and have seen the fossils and quartzite pebbles in the same fragments side by side.

II. The observations on the North Range were made about the Lower Narrows of the Baraboo river and westward from there about half a mile. This north range seems to be less continuous both as to elevation and as to the character of its rock material. I am told by Dr. Lapham that it seems rather to be made up of detached masses of metamorphic rocks. The rising ground, however, never entirely disappears, and the quartzite seems to be found as far to the east and west as in the south range. At the Baraboo Narrows the metamorphic rocks are in great force, the cliffs on either side the river, which here makes a direct cut through the range from south to north,



SECTION 2.—Through North range at W. Bluff of Baraboo Narrows. A, thick-bedded dark colored quartzites, with some talco siliceous schist; B, siliceous schist; C, horizontal sandstone; B. V, Baraboo Valley.

being as much as four hundred feet in height. The body of the bluff on the west side is made up of heavy beds of quartzite, with, in places, intercalated beds of metamorphic conglomerate, and of a talcose schist like that in the south range. These beds all stand at a very high angle, between 75 and 80 degs. from the horizontal, the dip being north, with possibly a slight inclination to the east. At the bottom of the hill on the south side is an exposure of a peculiar light-colored siliceous schist, entirely different from any of the other rocks of the series. An old shaft sunk some thirty feet on the schist, affords most

excellent opportunity for examination. The total thickness seen was about twelve feet, the layers varying in thickness from a few lines to four or five inches. Very thin films of a talcose material sometimes appear between the layers. Directly above this schist, I found a horizontal undisturbed sandstone, laid open for some distance by quarrying. The beds are generally a foot or two in thickness. In the loose pieces near by is found *Scolithus linearis.* The sandstone is, of course, the Potsdam of the surrounding valleys. Section 2 will serve to give a clear idea of the structure of this bluff.

The narrow detached ridge just to the westward, represented on the map, is also made up of horizontal Potsdam sandstone. There are many other such detached ridges along the Baraboo valley, bearing the same relation to the quartzite ranges, and showing the same horizontality of strata.

The following arguments in favor of the priority of these rocks to the Potsdam period will, I think, after what has been said, be admitted as valid. I give them in the order in which they became apparent to me.

1st. *The limited area of disturbance;* the undisturbed Potsdam and Calciferous strata being found north, south, and between the ridges, and in close proximity to them.

2d. *The absence of any anticlinal axes.* Dipping as the rocks do uniformly to the north, in order to place them in the Potsdam category, we must imagine a metamorphism of the strata, accompanied by a great fault, having on one side the unchanged sandstones, and on the other the tilted quartzites and schists, an idea new, I think, to geology.

3d. *The occurrence of rounded pebbles of quartzite in the conglomerate on the south side of the south range.* To suppose this conglomerate, which by its fossils is unmistakably Potsdam, to be of the same period as the quartzites below, we must suppose that period to have lasted long enough to cover the deposition of the quartzites as sandstones, their metamorphism, and the rounding of the pebbles by beach action, before the forma-

tion of the conglomerate; not to speak of the time sufficient to erase all signs of an anticlinal.

4th. *The occurrence of horizontal sandstones resting unconformably on the flanks of the tilted strata.* This last is, of course, absolutely conclusive as to the *north range*, but lest it might be claimed that the two are independent, I have given the others.

Mr. Winchell argues that, since Mr. Hall states that the fossils I have mentioned as occurring in the conglomerate are restricted to the Middle Potsdam, either this statement must be untrue or the quartzite must be the downward continuation of this formation. This argument, however, loses all force when we regard these ranges as high ridges in the Potsdam seas, never having been entirely covered by these seas, but having merely had the new sandstones and conglomerates deposited about their flanks. The place where these fossils were found must be *at least* 200 feet above the base of the sandstones of the surrounding country. A single glance at Dr. Lapham's geological map of Wisconsin will show this. The conglomerate is by no means necessarily the *base* of the Potsdam because it rests immediately on Huronian or Laurentian rocks.

In the final report of Mr. Hall already referred to, he mentions a low hill north of Baraboo, in which the middle of the hill is quartzite, and the flanks conglomerate and sandstones graduating upward into calcareo-sandy layers, without giving any further explanation. This statement, before somewhat unintelligible to me, now throws further light on my own results.

To my mind these ridges were unquestionably islands in the Potsdam sea, and a more beautiful illustration than is furnished by the sandstones and conglomerates of wave action on a rocky coast, can hardly be imagined.

There are many very interesting details of structure in these ridges which would repay thorough study. The points pre-

sented in the present paper are only those necessary to show the age of the rocks.

There are several more of these scattered quartzite ranges in Wisconsin, all but one of them occurring within the Potsdam and Calciferous areas. During the coming season I hope to be able to make a connected study of them.

UNIVERSITY OF WISCONSIN, November 18, 1871.

SUGGESTIONS AS TO A BASIS FOR THE GRADATION OF THE VERTEBRATA.*

BY T. C. CHAMBERLIN, A. M.,
Professor of Natural Science in the State Normal School, Whitewater.

Some of the leading principles stated in this scheme have been advanced by others, and form important considerations in the several classifications advocated by our leading naturalists, yet the author has seen no systematic scheme embodying them *as a basis for gradation as distinguished from classification*, and some of the principles have not, to his knowledge, been previously stated. To whom credit is due in reference to particular facts or principles cannot readily be stated. The author advances it with deference, because he cannot command that multitude of facts that are necessary to *establish* the claims of any system in zoology. Great difficulties arise to the amateur student away from the great libraries from the state of zoological literature, and under any circumstances from the want of sufficiently full and accurate observations on the nervous system. It is not intended to advance assertions, but suggestions. The suggestions here made, if of value at all, may be of value beyond the vertebrata.

This scheme differs from most others in being founded on a single organism, the nervous. This, at first thought may seem a fatal objection. But it must be remembered that there should be a clear distinction drawn between *rank* and *classification*. It will doubtless be conceded that a cephalopod ranks

* This subject was originally presented to the Academy in the extemporaneous style from notes and diagrams. The notes, which were not closely followed, constitute the abstract which appeared in the BULLETIN. As it is impossible now to reproduce the actual presentation, and as it is of no importance in preparing this article for publication here, I have taken all the liberties of original presentation.

higher than an annelid, and on the other hand that the insectea outrank the bryozoa. Yet the first is classified with the last and the second with the third, the rank and the classification resting on entirely different grounds. While it must be admitted that a classification based upon a single portion of the physical system would be of little value, it does not follow that this is true of gradation. It is true, a classification may be made on the basis of rank, but it is manifest such a classification would be most arbitrary and unnatural. Array all the animal kingdom in a line according to rank from the lowest to the highest, and then cut that line into as many or as few pieces as you please, and cut it where you please, and it is evident that the classes thus formed would be heterogeneous and unnatural. Radiates, mollusks, and articulates would be mingled confusedly with each other, and, doubtless, even with the vertebrata. And even though a classification be based upon rank, it would not make the two synonymous. Classification would then simply be founded on rank as it is commonly founded on structure. This distinction between gradation and classification does not seem to have been apprehended in its full force. *A true classification must be based upon differences in kind, a true gradation upon differences in degree*, differences in kind being reduced to a common standard by some system of equivalents. In establishing this system of equivalents lies the great difficulty of gradation. The manifest problem when we attempt to determine rank by specialization or otherwise in the various organs, lies in determining the *comparative value* of such indications. How much will *a modification in locomotion* weigh in the scale of rank when set over against *a modification in respiration?* How much *a mental characteristic* compared with *a physical adaptation?* How much of *superior specialization in a limb* will counterbalance *a given amount of intellectual, moral or social development?* It is true, this difficulty arises to a certain extent when we take for our basis the nervous system; yet, I think, here *nature has*

largely done this work for us, has made the comparison and given us the results, and herein lies its especial fitness to be our guide. A mental power and a physical form are so diverse in their nature that, considered independently, it is not apparent how they can be rationally compared at all. But the nervous system is a common medium for their action and furnishes the means of comparison. Where two organs of diverse natures act by means of separate and exclusive ganglia, those ganglia, it must be admitted, furnish the true means of comparison. And though the ganglia presiding over the various organs may not be thus distinct and exclusive in general, that does not vitiate the principle, but only affects its application.

Furthermore, the objection to this single organism as a basis is very much answered, so far as it has any bearing on gradation, when it is remembered that the nervous system is *comprehensive* in its nature. It is headquarters and source of co-ordination for all the functions of the whole system. It in a sense comprehends them all. This is a fact of supreme importance in gradation though it may be valueless in classification.

The nervous system is likewise *representative* in its nature. Complication in any other system of the body implies corresponding complication of the nervous system, *and implies it in terms of the common standard.*

Moreover, the nervous system comprises the highest form of organized matter. We should then expect its forms to be most indicative of rank.

And further, while it is generally conceded that intellectual characteristics have little value in classification, if indeed they should not be entirely ignored, they must from the very nature of the case form a most important element in the estimation of rank. Classification should be based upon structural affinities, gradation upon functional power. Classification, if true, is but an interpretation of nature; gradation is a judgment passed upon it. Classification is natural; gradation is

artificial. Gradation being thus a judgment must have its basis. Whether it has been distinctly recognized or not, the same one has been instinctively and universally adopted, viz: *power*, physical and psychological, qualitatively as well as quantitatively considered. This is made prominent in Prof. Dana's articles on "Cephalization as a Basis of Classification," and is a clearly recognized ground-work of his ideas, so far as they are gradational in their nature. Most writers, while consciously or unconsciously recognizing the basis, have looked to the principle of "division of labor" for a decision. While this is an important element of power, it is not the sum total nor any sure indication of it. But the point I wish to make in this connection is this, power is by no means all physical. Intellectual and moral forces cannot be ignored. A gradation that does not recognize these is as false as a classification based exclusively upon them. Now the nervous system is the especial instrument of mental manifestation. Its forms indicate, so far as they can be interpreted, the mental characteristics. Are we not compelled then to seek in its forms, and in its developments, that natural co-ordination of mental and physical indices of rank which alone can form a rational basis of gradation? That the systems commonly relied upon do not give us the truth approximately and in a general way is by no means asserted. The general truth of their results is assumed, and is made the basis of what arguments are here presented.

The following are suggested as indicative points:

1*st.* *Position of the general line of the cerebro-spinal axis.*

This is essentially horizontal in fish, acknowledged to be the lowest of the vertebrates; perpendicular in man, the highest; intermediate in a general sense in the intermediate orders. These facts have been frequently noted and appealed to as indicating rank. Some difficulties in application and sources of error exist, owing to modifications due to habits of life and

variety of posture. It is to be regarded as of only general value. Stated as an affirmation, the first principle will be:

The nearer the approach of the general line of the cerebro-spinal axis to the perpendicular, the higher the rank.

2*d.* *Angle formed by the axis of the spinal cord with the axis of the encephalic ganglia.*

The lines coincide approximately in fish, are nearly at right angles in man, are intermediate in the intermediate orders. This principle, like the preceding, can be regarded as of only general value. The angle of these axes is manifestly dependent in many cases upon the form and habitual position of the animal. The angle is large in the mole, rat, and similar burrowing animals for obvious reasons, and on the other hand when the habits of the animal require the longitudinal axis of the face to be more or less transverse to the cervical vertebræ, the angle is modified accordingly. The facts under these two heads then are rather representatives of the position and form of the body in general, and of positional relations of the nervous system to it, than characteristic of the functional relations of the system itself. Hence their inferior utility. Yet they are not without their value, and they show the representative character of our basis. Stated as a conclusion, the second principle will be:

The nearer the approach to a right angle, the higher the rank.

3*d.* *Degree of separation of the encephalic ganglia from each other.*

Ready and prompt inter-communication, with efficient co-ordination are necessary to the higher complex mental and physical manifestations. Positional concentration facilitates this. So long as the nervous action is of the simple reflex nature, the nearer the several ganglia are to the organs with which they are connected, the more favorable their position for performing their functions. But when co-ordination and combi-

nation of nervous action become predominant, the greater the concentration, the more efficient the action. This co-ordination will depend partly upon positional and partly upon commissural relations. One element of position is degree of separation. We should then, beforehand, expect to find those portions of the nervous system which are devoted to local and, in a measure, independent functions of the simple reflex nature scattered more or less, their position being determined rather by that of the organs whose action they control, than by their relations to other parts of the nervous system; while on the other hand we should expect to find those parts whose office is the organization of thought, feeling and co-ordinated motion, or whose function is closely related to these, collected together, forming a great nervous center, more and more concentrated and compacted as the co-operation of parts becomes more prompt and efficient. We find it to be so. It is but a common observation of naturalists, and to a greater or less extent its gradational value has been recognized.

The scattered situation of the sympathetic ganglia is marked as well as their separation from the encephalic centres. So of articulata, mollusca and radiata. The spinal cord, regarded as a nervous centre and performing functions a grade higher, has a better relationship but not a close one. In the lowest vertebrata the encephalic ganglia are markedly separate. As we proceed upward the separation is less and less marked, till in man aggregation reaches its highest state.

The less the separation the higher the rank.

4th. Relative position of the parts.

This is intimately connected with the preceding principle and has the same general import, but yet is in a measure distinct from it. In the amphioxus the arrangement is purely linear, and in all the cyclostomes there is little variation from it. In the higher fishes there begins to appear what may be termed a *two-ranked* arrangement, the cerebrum and cerebel-

lum being super-imposed upon the sensory ganglia and the medulla oblongata. This two-ranked arrangement is persistent in a more or less marked degree through all the higher orders, rank being indicated by advance from a rectilinear to a curvilinear arrangement. In the lowest orders in which this arrangement appears, lines drawn through the two series of ganglia are approximately parallel straight lines, in the highest they are approximately concentric semi-circumferences. This curvilinear arrangement has a double significance. It is the combined result of *a tendency to a compact arrangement and a relatively large development of the upper series.*

Much has been said on the relative position of the parts, especially of the cerebrum and cerebellum and more or less significance attached to this principle, yet observation in this direction seems to have been special rather than comprehensive.

Position with reference to the head of the spinal cord is worthy of especial attention. From a strictly posterior position, the spinal axis passes, as we ascend in rank, through almost a quadrant to a sub-central position beneath. The import of this, as facilitating co-operative intercommunication is apparent.

Embryology furnishes striking facts bearing upon this subject as it does upon other points discussed in this article. But I shall not here insist upon them, for we are, perhaps, not safe, as yet, in assuming that embryological development is along a line of uniform gradational advancement, however true this may be as a general fact. Until there shall be greater uniformity of opinion as to the origin of species and the relations of embryology to that subject, arguments based upon it must be regarded as questionable to a certain extent. But its general indications must be allowed considerable value, whatever views of development may be entertained.

Stated as a deduction, the fourth principle will be,

The more compact the arrangement of the parts, the higher the rank.

5th. Presence or absence of certain parts, especially connecting parts.

The corpus callosum, which in the higher mammalia is the largest and most important mass of commissural fibers, is wanting below that class and has a markedly varied development within it. The pons Varolii and other commissures are wanting in many of the lower forms, the anterior commissure being the only one traceable in fishes. The absence of these parts indicates want of association in action and consequent want of power to perform the higher complex functions, either mental or physical. A single illustration from Dr. Carpenter: "It is interesting to observe that in many Lepidoptera and Hymenoptera, which are remarkable for rapid and powerful flight, the nerves supplying both pairs of wings, are united at their origins. On the other hand, in many insects which are not remarkable for velocity or equability of motion, the nerves supplying each wing originate separately, and have little communication, just as in the larva of the Sphinx; and in the Coleoptera, in which the upper pair or elytra are motionless during flight, the nerves frequently remain entirely separate."

Absence of commissural parts indicates low rank..

6th. Relative size (a) of ganglia of the same animal (b) of a single ganglion to the whole body, (c) of the encephalon and of the entire nervous system to the whole body—(d) of the parts of the same ganglion, (e) of connecting parts.

(*a*) It will not be questioned that the several ganglia perform different functions, that some of these functions are higher and some lower, that size, with modifications, indicates their functional power, that the cerebrum performs the highest functions, that there is a scale of rank for the others, whatever it may be. It is almost axiomatic then to state that the larger the ganglia of high functions the higher the animal's rank. The cerebrum in the lowest vertebrates is entirely wanting, in all the lower orders it is relatively small, in the higher

relatively large. In many fishes the optic lobes alone are larger than the cerebrum. In man, at the other end of the series, the cerebrum is very much larger than all the remaining encephalic ganglia combined. Between these extremes there is every degree of gradation.

Under this head may be included the suggestion of Dr. Carpenter, that a comparison of the bulk of the cerebrum with the diameter of the spinal cord would give more accurate results than a comparison with the whole body.

(*b*) Unsatisfactory as this comparison is in some respects, and inferior as it may be to that suggested by Dr. Carpenter, it yet has much value, and when its results have been carefully corrected, for density, quality, activity, etc., it will be found free from most of the objections urged against it. It must not be expected that any one comparison will show all of the truth, especially when the truth is so complex as here. Each one shows its peculiar phase. All must be combined to give all phases and the true result.

With modifications, the larger the cerebrum, compared with the whole body, the higher the rank.

General estimates would seem to indicate that the law of the cerebellum, considered individually, is the same, subject however to more important modifications.

(*c*) Comparisons of the cerebrum are especially indicative of intelligence. But this is not the only element of the problem. Power of the more physical kind must be computed and combined with it to give correct results. Given two animals of equal intelligence, the one which has the greatest muscular power, either quantitative or qualitative, must rank the higher. Comparisons of the encephalic mass and of the entire nervous system must be made, to correct errors arising from this source.

(*e*) The size of connecting parts is an additional item bearing upon the co-operation of the parts, and taken in connection with what has been said already, and with the fact that the commissures are introduced at different points in the scale,

and that their development is markedly varying, renders this a most highly indicative item. Attention should be given to longitudinal bands as well as transverse.

(*d*) The parts of a ganglion, especially of the larger, have different degrees of development, and if, as many believe, the different parts have different functions, the relative size of each must be indicative, and, whether functional differences are conceded or not, inductive study shows it to be true at least in a general sense. The anterior lobe of the cerebrum is much more developed in man than in the apes or any of the higher mammals, and in these, than in the lower orders. The posterior lobe, as such, does not appear at all except in the highest mammals. Similar significant facts are presented by the other lobes of the cerebrum and by those of the cerebellum. The development of the anterior, upper, and posterior parts of the cerebrum especially indicate high rank. This is intimately associated with and in a measure determines the form of the parts which, however, is thought worthy of being considered under a separate head.

7th. Absolute size.

Given two animals, alike in every other respect, the one that possesses the greatest nervous mass must rank the higher. Size is one measure of power. Prof. Dana in his articles on "Cephalization" has given to a somewhat different application of this principle, the importance it merits, and which seem to have been overlooked or disregarded by other systematists.

8th. Form of the parts, especially of the cerebrum.

The attention that has been paid to the form of the skull by ethnologists, indicates the value of this point; but a higher value, the author believes, attaches to the form of the brain itself than to its representative, the skull. The deductions of ethnologists from the form of the skull, however, must be accepted in general, when applied to the brain itself. What-

ever may be thought of the technicalities of the doctrines of Gall and Spurzheim, the general truth that the form of the brain indicates the form of the character can scarcely be questioned. The force of observations in this direction will be measured somewhat accurately by the degree of development of the organ, the form being most significant when the development is highest.

9th. Relative position and amount of grey and white matter.

The general position is not a variable element, but is worthy of notice as indicating the functions of the several parts; the tendency of the grey matter being toward the outside for the higher functions and toward the inside for the lower. No especial value is attached to this.

The presence, number and depth of the convolutions have been regarded as especially characteristic of rank. The variations of the human brain in this respect, and its correspondence with character have been appealed to; as also the fact of their late introduction into the scale of creation. A comparison of man with other mammals, with birds, with reptiles, with fishes, is conclusive as to the general truth that numerous and deep convolutions signify elevation of rank. This rule, however, taken by itself would elevate the cerebellum above the cerebrum, and, if the general way in which Prof. Huxley states the facts does not deceive me, aquatic carnivora above terrestrial, and would give a much higher rank to the cetacea than is usually accorded them. But in the cetacea on the other hand the limited development of the commissures indicates low rank, so that here, as elsewhere, the indications of different parts are not always in harmony, which shows the necessity of collating and combining all the indices. On this subject a word at the close of the article.

The amount of vesicular matter is an important item. The functional power of the organ is doubtless more accurately indicated by this than by the entire mass.

10*th.* *Density.*

The actual amount of nervous matter is to be regarded rather than the space it occupies. Some ganglia are hollow in one order and solid in another. Errors are liable to arise from this. Again the structure where solid may be more dense in one case than in another. The specific gravity will be a valuable guide. Simple weight will not answer. A dense structure will unquestionably differ in functional power from a loose one of equal weight.

11*th.* *Quality of the nervous organization.*

This, unquestionably, it is difficult to determine with certainty and precision, but its significance cannot be questioned. It is a very important element in determining superiority among men, where it can be estimated somewhat accurately, and it is doubtless equally so among the whole class vertebrata. A general harmony of structure pervades the organization of an animal. Coarseness in one part is usually accompanied by coarseness in all others, and *vice versa.* It is not difficult to determine the general quality of the organization as a whole, and thus we may form a general though somewhat uncertain estimate of the quality of the nervous organization. What assistance microscopic study may lend in this estimate is not yet demonstrated. That it will be important, it is reasonable to hope.

12*th.* *Activity of the nervous system.*

Like quality, this may be difficult to determine, but yet it is important. Yet I think, in the amount and in the changes of the blood sent to the brain, we have a reliable index of its activity. I am not aware that any observations, save a few by the author, have been made with this end in view. Yet the value of such observations are apparent upon a mere statement. And that value is not confined to the determination of activity merely, but of the total amount of nervous force. The

chemical and molecular changes of the blood sent to the nervous centres are regarded as the true measure of the nervovs force generated. The amount of this force compared with the amount of nervous substance should show the activity.

13*th*. *Relative development of the sympathetic and cerebro-spinal systems.*

The comparative rank of the two systems is unquestioned. The distinct differentiation of the latter from the former marked a large advance upon previous structures. The relations of the two systems must then be indicative.

The indications of a single one of these rules alone is not to be regarded as decisive. The fallacy of most of the objections that have been urged against such of these rules as have been previously advanced lies here. Because they have not been universally decisive, their value within the sphere of their application and with the modifications and corrections to which they are subject, has been falsely estimated. That that sphere and those modifications and corrections can be ascertained and their relations adjusted, is the firm belief of the author. It is the combined and corrected result of all these rules that is to be decisive. And as their indications are not always harmonious when two subjects are being compared, the question of their relative value arises. This question, as I have attempted to show, has not by any means the significance it has when applied to a system based upon the various organs of the system. But whether more or less significant, the author is not yet prepared to answer it, except in generalities.

ANCIENT LAKES OF WISCONSIN.

BY HON. J. G. KNAPP, MADISON.

Few persons have reflected—probably because their attention has not been directed to the subject—upon what barriers have been cast across the courses of our rivers; and how they have been removed by the action of water and drift, in the long periods of the past; what immense tracts were once covered with water, forming fresh water lakes, where now men plow, hoe and tend crops, and human habitations stand. To enlarge or particularly define any locations is not intended, but to call attention to a subject scarcely noted.

The Mississippi dam may be located just below the mouth of the Wisconsin, where the strata of rocks rise on each side of the river in unbroken series, several hundred feet. If these strata were carried across the river, and the supposition is not violent, since the strata are nearly horizontal, and there is no evidence of violent terremotal action at this point to break down the strata since their deposition, then both streams would be backed up and made to cover their present valleys; the Mississippi to the Falls of St. Anthony and the Wisconsin to the Baraboo bluffs. This barrier is out of the drift region, and has been broken down by the action of water. If the next supposition be warranted, the Wisconsin river was much smaller than at present.

The Baraboo barrier next deserves attention. This elevation was united with the high lands on the east of the Wisconsin in the southern towns of Columbia county, thus forming a large lake into which the Wisconsin, Baraboo, Duck creek and Fox rivers emptied, and which then belonged with the Wolf river to the Lake Michigan watershed, as the Fox yet does. The

Swan lake, east of the portage, and the deep holes in Big Slough appear to be remnants of this lake. The barrier has been broken down, and much of the filling up has been done by glacial action, as here is near the western boundary of that action. Where the eastern boundary of this lake was located we may never know, since all monuments of its former existence may have been swept away by the glacial action, which spread over that whole region. For the same reason it will be difficult to accurately determine the former character of the lakes and valley of the Upper Fox and Wolf rivers; whether they are remnants of one immense lake or parts of several, or whether they were deep cavities in the ancient Potsdam sand rocks or scooped out during the glacial period, we may never be able to determine with any degree of exactitude.

Lake Winnebago was once much larger than at present. The ancient boundaries may be readily traced, at about the same level as the present clay banks at Appleton, which have been cut through with the entire channel of the lower Fox since the drift period, and the clay deposits. That higher lake level may have been sufficient to have mingled the waters of Lake Winnebago with the Horicon, during the existence of the present fauna, since the fishes of Lake Winnebago and Rock river, with few exceptions, are identical even to varieties.

The extensive lakes found in the drift, with the adjacent wet meadows and swamps, owe ther origin to the glacial action, and their drainage has been the work of water, and in most cases so gradual, yet continuous, that the ancient beaches have been obliterated, if ever formed. These will each present peculiar characteristics, and must be studied as individuals, and not as a whole system.

The Upper and Lower Dells of the Wisconsin present us with the result of the action of water in slowly cutting down the sand rock, and emptying one of the most extensive of the Wisconsin lakes. This lake, and the water-worn outlet was exterior to the drift range, and was one of the largest fresh-

water lakes in the state. The existence of this lake will be seen in the few shells that may be found imbedded beyond the present beds of the river and its branches.

Other points might be mentioned, but the intention has been only to direct attention to this subject, not to write an exactly scientific paper.

ON THE MINERAL WELL AT WATERLOO, WIS.

BY REV. O. A. WRIGHT, A. M., NEW LISBON.

The well referred to in this paper was dug in the fall of 1857. A strong vein of water was found at about ten feet below the surface, and in a stratum of sand some two feet thick. The direction of its flow was from north to south—opposite to the course of Waterloo creek. It flows from underneath a ridge some twenty or thirty feet high, which seems to be nothing more than the ordinary swell of the prairie, with nothing peculiar in its geological formation, being mainly formed of what is usually known as the glacial drift. The vein is not inexhaustible, but gives the well a capacity of about twenty-five barrels a day.

The mineral properties were first discovered when it acted as a cathartic upon the horses that were watered at the well; this being the only purpose for which the well was used, on account of its peculiar taste. A gallon of water was sent to Mr. J. H. Tesch, of Milwaukee, by whose analysis it was found to contain:

	Grains.
Chloride of sodium	23,345
Chloride of potassium	7,060
Chloride of calcium	28,779
Chloride of lithium	12,089
Nitrate of soda	36,017
Sulphate of magnesia	11,490
Bi-carbonate of magnesia	15,786
Bi-carbonate of lime	13,416
Silica	1,343
Total	149,275

ON POTENTIALS AND THEIR APPLICATION TO PHYSICAL SCIENCE.

BY PROFESSOR JOHN E. DAVIES, M. D.
Of the Wisconsin State University.

In most of the recent Mathematical discussions of Physical Theories and Problems, or where laws of nature, first established by observation or experiment, are afterwards followed to their legitimate consequences by the application of analysis, we find a certain Function used, which, on account of the admirable simplicity it introduces, gives great elegance and brevity to the demonstrations, and the nature of which should, therefore, be thoroughly known.

For attracting bodies, we read of the Potential of the attracting mass, at some given point external or internal to the mass itself; of Heat Potentials; of Potentials of Stress, Elasticity, &c., &c. In short, the Function is evidently one of such great generality and power, as to be adapted to most cases where the effects of any forms of Force (attractive or repulsive) are to be considered. It is thus of indispensable service in the Dynamical Theories of Heat, Light, Electricity, &c., now so universally accepted as the true ones.

Any attempt, then, to present the exact meaning and nature of this Function in a clear light, ought to be of service to those who wish for that thorough comprehension of Physical laws, which mathematical analysis so much aids in giving.

The *Potential Function* for Gravitation was first introduced by Laplace in discussing the attractions of Spheres and Spheroids. (Mecanique Celeste, Book II, Chap. II,

§ 11, and Book III, Chap. I, § 4.) He makes use of it afterwards in discussing the Moon's influence in determining a tide at any point on the surface of the Earth (Book IV, Chap. I, § 1 et seq.); her influence on the protuberant mass about the Earth's equator, causing lunar precession (Book V, Chap. I, § 3 et seq.), and the reciprocal action of this mass in causing irregularities in the orbital motion of the moon. (Book VII, Chap. II, § 20 et seq.)

The introduction of this function enabled him to do away with difficult—in some cases *impossible*—integrations, and to substitute therefor the comparatively easy processes of differentiation.

It seems to have been used by Laplace merely as an Analytical artifice whereby to accomplish certain results in the calculation of attractions, by substituting *indirect*, but, as it proves, *easy* methods for direct but very difficult ones. He applies it, of course, only to the force of gravitation.

Afterwards, in 1828, the term *Potential Function* was applied to it by George Green, a poor operative, in Nottingham, England, whose mathematical labors in the intervals of his other labor raised him to such notice as to cause him to be sent to Cambridge at the age of forty; and to be now regarded as one of the greatest contributors to Mathematical Physics. His papers have recently been published by Messrs. Macmillan & Co. in one volume, edited by Prof. N. M. Ferrers. They are models of analytical elegance and skill.

Green's treatment of the *Potential* is, however, purely analytical. He seems, also, to take it for granted that all that LAPLACE had already written upon the subject in the case of gravitation was well known to those who heard or read him. He first applies this function to distributions ot Electricity and Magnetism over bodies of various form.

The only interpretation Green gives to this Function is that which LAPLACE had already given, viz.: that it is a quantity such that its partial differential, with respect to any co-ordinate x of a point p, will give the attraction due to the mass along any line chosen for the co-ordinate axis X; that, letting x', y', z' be the *rectangular co-ordinates* of a particle of any attracting or repelling mass, ρ' its density, dx', dy', dz' its sides regarded as an elementary *parallelopipedon*, r' the distance of this element of mass from an attracted point p exterior to the body, then

V = Potential Function of the whole mass at the point p

$$= \int \frac{\rho' \, dx' \, dy' \, dz'}{r'}.$$

The integral comprehending every particle (or elementary mass) in the entire mass.

Green's own words, in beginning his essay on Electricity, are: "*It is well known*, that nearly all the attractive and repulsive forces existing in nature are such, that if we consider any material point p, the effect, *in a given direction*, of all the forces acting upon that point, arising from any system of bodies S under consideration, will be expressed by a partial differential of a *certain function* [the Potential] of the co-ordinates which serve to define the point's position in space. The consideration of this function is of great importance in many inquiries, and probably there are none in which its utility is more marked than in those about to engage our attention. In the sequel we shall often have occasion to speak of this function, and will, therefore, *for abridgment*, call it the *Potential Function* arising from the system S. If p *be a particle* of positive electricity under the influence of forces arising from any electrified body, the function in question, *as is well known*, will be obtained by dividing the quantity of electricity in each element of the body, by its distance from the particle p, and taking the total sum

of these quotients for the whole body." [This is expressed by the above integral.]

It will thus be seen that Green's definition is purely mathematical; and, moreover, that he supposes the nature of the function already well known. The object of his essay was "to deduce certain relations between the values of this function for different points, and the densities of Electricity or Magnetism that give rise to these 'values.'"

The object of the present paper is to attempt to give a *Physical* interpretation to this Function and to illustrate it and its use by some simple example. Suppose, then, a body, say a material particle, be lifted to any point p above the surface of the earth; the co-ordinates of this point p, referred to the earth's center, being x, y, z. It is evident that, to do so, work must be done by some agent against the earth's gravity; the amount of this work depending solely on the distance of p and the total attraction of the earth, the mass of the particle raised being supposed constant. This particle *contains* this work, as it were, *stored* in it, and will give it off in overcoming resistances on its way back to the earth. The Sun expends work—its heat—in raising the waters of the earth into clouds. These clouds overcome resistances, or, in other words, *do* work on their way as cataracts back to the sea. For all different values of the co-ordinates x, y, z, of the point p, we shall have different values for the work done against gravity in raising the particle to this point. Were the particle to remain stationary at p, having constant co-ordinates a, b, c, this work would change in amount also, by supposing the mass or attracting power of the central body to change. There is thus seen to be a certain definite quantity of *work-power* between bodies endowed with mutually attractive or repulsive forces, which work-power depends in amount on the strength of the mutual forces and the space separating the bodies of

the system. *This quantity*, thus shown to be a function of both force and space, *is the Potential Function.* The integral

$$V = \int \frac{\rho' \, dx', dy', dz'}{r'}$$

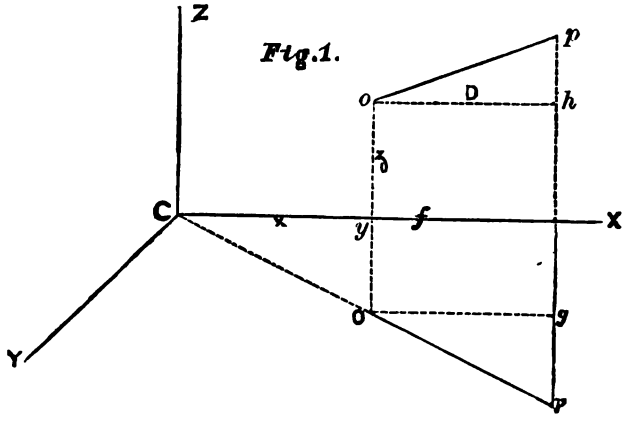
is its analytical expression, and means what we have just indicated. The Physical idea it represents is, therefore, *work*, or *energy*.

It is a quantity representing not the *actual* energy of work *being done*, but the *possible* energy due to work *already done*. It is a consequence of the inertia of matter and the indestructibility of force. Energy exerted is not energy lost, but energy stored or transformed. Potential energy is energy stored. The Potential energy of Elasticity is, according to Rankine's definition, the *work* which a body, in a state of strain, is capable of performing in returning to the free state. The Potential energy of Heat is, according to Clausius, the work which the moving molecules are *capable* of performing in being brought to a state of less energetic motion, or to rest; and Mohr has apparently shown that the Potential energy of Chemical Affinity is due to *atomic* motions *within the molecule*, which, on being lessened or destroyed, must be changed to Heat, Light, Electricity, or Mechanical work. In all these cases, the Potential Energy is a function of force and space, or its correlative, time. When expressed mathematically, it is the famous *Potential Function;* and its value is determined by the special circumstances of each particular case.

We will give an easy example of its application, in a manner which all students of Analytical Geometry and Elementary Mechanics will readily understand.

It is well known that if a material point whose co-ordinates are f, g, h, be acted on by forces whose resultant P may be regarded as emanating from O, a point whose

co-ordinates are x, y, z, then P may be resolved into three component forces acting along axes at right angles to each other, the values of which components will be $P \cos \alpha$, $P \cos \beta$, $P \cos \gamma$—alpha, beta, gamma, denoting the angles made by the direction of the force P, with the three co-ordinate axes.



Let the straight line joining p and o be called D. Then $D = \sqrt{(f-x)^2 + (g-y)^2 + (h-z)^2}$, and the expressions for the component forces will then become

$$\left.\begin{aligned} X &= P \cos \alpha = P.\frac{(f-x)}{D} \\ Y &= P \cos \beta = P.\frac{(g-y)}{D} \\ Z &= P \cos \gamma = P.\frac{(h-z)}{D} \end{aligned}\right\} . \text{(A)}$$

which are to be made negative when the force P is attractive towards O, as it then tends to *diminish* the distance D.

(A reference to Fig. 1 will show the applicability of these formulæ.)

If the force P be one which depends on the mass of a solid, like gravity; or, like Electricity or Magnetism, one whose accumulation or *density*, as we may say, is greater at some points than others; and if it also depend in any man-

ner upon the distance D, then the most general form we can give to P will be $\int\int\int \frac{\rho\ dx\ dy\ dz}{D^n}$:

ρ—denoting the varying density.

dx dy dz—the volume of an element of the solid or surface whence the force emanates.

n being any number, positive or negative; it will be positive in the above expression when the force varies *inversely* as some power of the distance; negative when the force varies *directly* as some power of the same; n being the degree of the power in either case.

The integration expressed in the equivalent value given above for P, is to be within such limits as shall include the entire volume of the attracting mass, or the entire surface over which the force, e. g., Electricity, is distributed.

Substituting this value for P, the expressions (A) will become

$$\left.\begin{aligned} X &= \int\int\int \frac{\rho\ dx\ dy\ dz\ (f-x)}{D^{n+1}} \\ Y &= \int\int\int \frac{\rho\ dx\ dy\ dz\ (g-y)}{D^{n+1}} \\ Z &= \int\int\int \frac{\rho\ dx\ dy\ dz\ (h-z)}{D^{n+1}} \end{aligned}\right\} \ldots\ldots (B)$$

In the case which is most common among natural forces, n will be *positive* and equal to 2. The force will then vary *inversely* as the square of the distance.

Taking this case as the easiest apprehended, and substituting for D its value before given in terms of f, g, h, — x, y, z, equations (B) will become

$$\left.\begin{aligned} X &= \int\int\int \frac{\rho\ dx\ dy\ dz\ (f-x)}{[(f-x)^2+(g-y)^2+(h-z)^2]^{\frac{3}{2}}} \\ Y &= \int\int\int \frac{\rho\ dx\ dy\ dz\ (g-y)}{[(f-x)^2+(g-y)^2+(h-z)^2]^{\frac{3}{2}}} \\ Z &= \int\int\int \frac{\rho\ dx\ dy\ dz\ (h-z)}{[(f-x)^2+(g-y)^2+(h-z)^2]^{\frac{3}{2}}} \end{aligned}\right\} \ldots (C)$$

If, then, we wish to ascertain the amount of attraction or repulsion exerted upon some material point whose co-ordinates are f, g, h, by a heterogeneous mass or an electrified surface, the integrals (B) or (C) will enable us to write down the values of the component attractions along the axes X, Y, Z at once. But to evaluate these integrals is always difficult; in some cases *impossible.* A careful *inspection* of them, however, will show that if we separate out from each one of them the quantity

$$\int\int\int \frac{\rho\, dx\, dy\, dz}{D}$$

$$= \int\int\int \frac{\rho\, dx\, dy\, dz}{[(f-x)^2+(g-y)^2+(h-z)^2]^{\frac{1}{2}}}$$

$= V$, say, then

$$\left.\begin{array}{l} \text{the whole expression for } X = \dfrac{dV}{dx} \\ \text{"} \quad \text{"} \quad \text{"} \quad \text{"} \quad Y = \dfrac{dV}{dy} \\ \text{"} \quad \text{"} \quad \text{"} \quad \text{"} \quad Z = \dfrac{dV}{dz} \end{array}\right\} \ldots\ldots\ldots \text{(D)}$$

Here, then, is a quantity V, which, when once a value is found for it, will give us the values of the attractions X, Y, Z, by a single differentiation of it with reference to x, y, or z. This quantity is the *Potential Function* which we have before explained; as is evident on a comparison of the two expressions.

To find V is generally far easier than to directly integrate the expressions for the components of force. Indeed, Laplace has given a general mode of expanding V into a series, which is both simple and beautiful. *To explain methods of finding the value of V in different cases,* is not the object of this paper;* but merely to call the more general attention of students of Physical science to the

* This is very fully done in Laplace (Book III, Chap. I, § 4); Green's Math. Papers, edited by Ferrers—Thompson & Tait's Nat. Phil., Vol. I.

importance of this Function by a simple explanation of its nature and use.

As a further example, we will apply it to finding the attractions of a Sphere, on an external or internal point. This, it is true, is a case in which it is easier to integrate directly the expressions for the attractions; but we use it merely as an example.

We already know by other methods that these attractions will be

$$\text{for an } \textit{external} \text{ point} = \tfrac{4}{3}\pi\rho \,.\, \frac{r^3}{x^2}$$

$$\text{“ “ } \textit{internal} \text{ “ } = 2\pi\rho\, r^2 + \tfrac{4}{3}\pi\rho \,.\, x$$

where r = radius of the sphere.

x = distance of attracted point from centre.

ρ = density of the sphere.

Let us get these values through the *Potential Function* in each case.

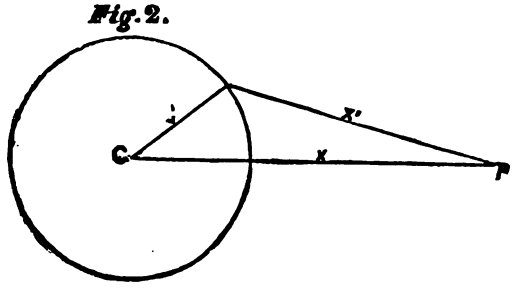
If r, μ, ω be the polar co-ordinates of any *surface* element of the Sphere, referred to the centre of the Sphere as origin;—r being the radius; μ, the cosine of the latitude (or better, the co-latitude); ω, the longitude of the element; ρ, the density of the sphere; then the

$$\text{Mass of this element} = \rho\, r^2\, dr\, d\mu\, d\omega.$$

If in Fig. 2, x' = distance of this element from p, then will, by ordinary Geometry,

$$x' = \sqrt{r^2 + x^2 - 2rx \,.\, \mu}.$$

Fig. 2.



Now by the definition of the *Potential*, it must be (designating it by V) $= \int_0^r \int_{-1}^{+1} \int_0^{2\pi} \frac{\rho r^2 \, dr \, d\mu \, d\omega}{\sqrt{r^2 + x^2 - 2rx \, . \, \mu}}$; i. e., the SUM of all the quotients arising by dividing each element of the entire sphere by its distance (x') from the attracted point.

Effecting this summation, we have

When p is without the sphere, $V = \frac{4}{3} \frac{\pi\rho \cdot r^3}{x}$.

" " within " " $V' = 2\,\pi\rho\, r^2 - \frac{2}{3}\,\pi\rho \, . \, x^2$.

Now it has been pointed out that when the Potential V has been found in any case, to get the attractions, we have only to differentiate V once; hence, when p is without, the attraction along $x = \frac{dV}{dx} = \frac{d\,(\frac{4}{3}\,\pi\rho\, r^3)}{dx} = \frac{4}{3}\,\pi\rho \, . \, \frac{r^3}{x^2}$, or the attraction is *directly* as the mass of the sphere, and *inversely* as the square of the distance from the center; *the known law.*

When p is within the sphere, the attraction along $x = \frac{dV}{dx} = \frac{d\,(2\,\pi\rho\, r^2 - \frac{2}{3}\,\pi\rho \, . \, x^2)}{dx} = 2\,\pi\rho\, r^2 + \frac{4}{3}\,\pi\rho \, . \, x$, the value of which will depend only on x (the distance from the center), since the first term is constant. The attraction within the sphere will therefore be *directly as the distance* from the center; *which is the known law in this case also.*

These simple examples, it is hoped, will sufficiently illustrate the nature, mode of application, and usefulness of the *Potential Function* when once an expression for that function has been found. And we have carefully indicated where full expositions can be found of the mode of calculating this most important function in all the cases that are likely to occur in the solution of physical problems.

DEPARTMENT OF THE ARTS.

VERMILLION BY A NEW PROCESS—ITS PHOTOGRAPHIC PROPERTIES.

MILWAUKEE, February 13, 1872.

Dr. J. W. HOYT, *President Wisconsin Academy of Sciences, Arts and Letters:*

MY DEAR SIR: Enclosed I send you a sample of *Vermillion* obtained by what I suppose to be a new process, without sublimation or heat, and without the use of an alkali, but directly from solution by deposition. I find no account of its being produced by such method in any work which I have been able to consult. As produced by my process it has *photographic properties*, which fact, I believe, has never been noticed. If deposited in a weak light, or in the dark, it turns much darker on exposure to strong light while yet remaining in the solution from which it was deposited. This property gives the substance great value in its application to photography, for prints after being toned by the mercuric sulphide become more deeply impressed after completion; whereas by the usual method the last thing done in the production of the print is to subject it to the action of hypo-sulphite of soda, which greatly weakens the force with which it adheres to the organic surface. This sulphide is a stable substance, does not dissolve in nitric, muriatic or sulphuric acid except by aid of heat, and is not affected by ordinary conditions of the atmosphere; and by enveloping the silver and gold depositions composing the photographic print, with it the print is thus enabled to resist the destructive

agencies which otherwise would cause it to fade. The reactions which take place in the formation of the sulphide in question are probably represented by the following equation:

$$Na^2 S^2 O^3 + Hg Cl^2 + NH^4 Cl =$$
$$Hg S^2 + 2(Na Cl) + NH^4 Clo^3.$$

The vermillion itself does not rival the commercial product in beauty of color, but I think will do very well for the first result of a new process. I expect to learn to produce a finer article.

Until very recently, I had expected to be present at your next meeting and present this matter in person to the Academy, together with illustrative specimens, but circumstances will prevent.

Very truly yours,

W. H. SHERMAN.

DEPARTMENT OF LETTERS.

THE RURAL POPULATION OF ENGLAND,

AS CLASSIFIED IN DOMESDAY BOOK.

BY WILLIAM F. ALLEN, A. M.,
Professor of Latin and History in the University of Wisconsin.

Domesday Book is the record of a survey of the landed property of England, made by William the Conqueror, when he had been about twenty years on the throne; it was completed in 1086. It contains a nearly complete census of the rural population and property of the whole country, with the exception of a few of the northern counties, which were in too disorderly a condition to be reported in detail. For some parts of the country there remain also the preliminary memoranda, which are considerably more detailed than the final report; these are the "Exeter Domesday," for the western counties, and the "Ely Inquest," for the estates depending upon the abbey of St. Ethelred of Ely. For the counties of Norfolk, Suffolk and Essex, this preliminary register is all that is extant.

These documents give us a more exact and detailed knowledge of the condition of England at this early date, than we possess for any other country of Europe. And, nevertheless, such are the inherent difficulties in the way of understanding the social condition of a period so far removed from our own, and so meagre is our collateral knowledge of the matters

treated, that there are many questions raised by an examination of these documents, which have never been satisfactorily answered. Among these is the precise status of the different classes of population enumerated.

The whole population recorded in Domesday Book is 283,242; the heads of families only, it will be remembered, and, in the main, only of the rural parts of England. These are enumerated in several different classes, to the four largest of which our attention will chiefly be confined. These are: the *villani*, numbering 108,407; the *bordarii*, 82,119; the *sochemanni*, 23,072; the *liberi homines* (free men), 12,138. There are also 25,156 slaves; but these do not come within the scope of our inquiry.

[The pages which discuss the *villani*, *bordarii* and *liberi homines* will be omitted, except the summary which follows of the general results of the inquiry.]

1. The *villani* appear to have been in the main the body of the *ceorls* or common freemen; the representative of the primitive Village Communities (see Maine, Vill. Comm., p. 82). "From all that we can gather on the subject, it seems that they were situated on the outside of the demesne land, and in 'common-field' culture." Larking's "Domesday Book of Kent," App., p. 30.

2. The *bordarii* were those who, through misfortune or improvidence, had lost their little estates, and been reduced to the condition of common laborers; together with emancipated slaves and such others as floated to the several localities from one place or another. These had cottages (*bord*), not in the "village" proper, but on the lord's demesne, or "in-land"; they became the villains in gross of feudal times, and their holdings were in time transformed into copyholds (see again Larking).

3. The *liberi homines* were independent freeholders, disconnected with the regular village or manorial organization of the peasantry; the large numbers of them that we find in Norfolk,

Suffolk and Essex, are to be explained by supposing them to be the descendants of the Danes of Guthorm (see Lappenberg's "Norman Kings of England," p. 202).

4. We come next to the *sochemanni*, who present undonbtedly the most puzzling problem connected with these inquiries. It seems to me, however, that the difficulty has arisen chiefly from the attempt to identify them with the socage tenants of later times, to whom also the term *sochemanni* was applied; and from the further attempt to explain the word by *socagium*, socage, which is itself a derived word, rather than by *soc* or *socha*, from which both of these must have been derived. It is easy to see how inadequate this method is. The tenants in "free and common socage" made up the body of the freehold tenants in all parts of England; but the *sochemanni* of Domesday Book are found only in certain counties in the east of England; so that the theory in question makes no provision for the socagers of Wessex and western Mercia. Further, it has been shown [in the pages omitted] that the *villani* held their lands by a tenure which was, to all intents and purposes, free and common socage, that is, a tenure "by any certain and determined service."* The *villani*, therefore, who are found in all counties of England, must be, in part at least, the representatives of the later socagers; consequently the *sochemanni* must have had something to distinguish them besides this tenure.

We must, then, leave the late and derived word *socagium*, and have recourse to the primitive *soc* or *socha*, and determine from this, on etymological grounds, the probable meaning of *sochemannus*. Etymology is a very unsafe guide to the actual meaning of a word at any given time; but it gives a certain clue to what must have been its meaning at one time—to one of the phases of meaning through which it must have passed. Thus, the derivation of *socage* has been greatly disputed, and, whatever this may have been, it is not at all a safe indication

* Blackstone.

to the meaning of *socman;* for, although the two words may have been, and probably were, derived from the same source, yet there is no likelihood that either was derived from the other. Now it is probable that *socagium* (socage) was derived from the Anglo-Saxon *sôc;* but it is almost certain that *sochemannus* was so derived. From the meaning of *sôc*, therefore, we can deduce, not what was the meaning of *sochemannus* at any particular epoch, whether at the time of the Conquest or two hundred years later, but what must have been its meaning when the word was first formed.

Sôc, in Latin *Socha*, is the territory of the jurisdiction of a thegn. As the village community was transformed into a manor, its territory came to be regarded as the property of the thegn or country gentleman, the "lord of the manor" of feudal times. More than this, as the development of feudal institutions went on, he became "not only a proprietor, but a prince," and the villagers not only his tenants, but his subjects. This was a gradual process. The rights of jurisdiction were at first granted to individual thegns, as a special privilege, or *franchise* as it was called. Some received them, others did not. A law of Edward the Confessor* contrasts "barones qui curias suas habent de hominibus suis" with "barones qui judicia non habent." Again, the franchise was not always in the same degree. Full powers of jurisdiction, civil and criminal, were comprised under the terms "sac, sôc, toll, team and infangthef"; a lesser degree, relating only to civil cases and petty offences, was "sac and sôc," or, very frequently, simply *soc.* Domesday Book gives the names of 35 persons, thegns and persons of high rank—among them Queen Edith and the Bishop of Durham—who had "sac, sôc, toll and team" in Lincolnshire; but in the city of Lincoln alone there were 12 who had "sac and sôc": one of them being mentioned specially as having also "Toll and Theim." After the Norman Conquest, when the feudal institutions had become fully developed, and

* Stubbs, Select Charters, p. 74.

the powers of jurisdiction had been parcelled out among the feudal tenants, they were an essential adjunct to every manor; but at the time of the Conquest, as we must constantly bear in mind, the system was still in process of development, and various stages of it were in existence side by side.

Soc, then, is the territory within which a thegn possessed jurisdiction; and it is often put for the jurisdiction itself, which was more properly expressed by *sac*. Illustrations of this use of the word are common in all parts of Domesday Book; but they are most common in Lincolnshire and the adjoining counties, in which the socmen are principally found. A peculiarity of these counties is that nearly every manor has enumerated as *Soca* a list of small detached tracts in other manors. For example (I take a very simple case), the manor of Tuxfarne, in Nottinghamshire, has 32 *villani* and 2 *bordarii*. As *Soca* belong; 1, in Schidrinton and Walesbi, 2 hides of land with 6 *sochemanni* and 1 *bordarius;* 2, in Agemuntone, 1 1-2 hide with 1 *sochemannus* and 3 *villani*. Agemuntone has a manor of its own, and in Tuxfarne itself is a *soca* of Westmarcham, containing 3 carucates of land, with 3 *sochemanni* and 5 *villani*. Lincolnshire and Nottinghamshire, and to some extent other counties in the neighborhood, are in this way cut up in a remarkable degree into small places of detached jurisdiction. It should be remarked that the *soc* varies very much; it appears sometimes to belong to a person, sometimes to a manor.

Now the term sôc was not properly applied to the *demesne* land, of which the lord of the manor was *proprietor*, but to the tenement lands, as they were called, of which he was the *prince*. The lands of a manor were strictly divided into two parts, both of which were essential to its existence. The *demesne* land, or "in-land," as it was called in Anglo-Saxon times, was the private estate or farm of the lord, where he had his manor house or castle, and lived surrounded by his retainers and serfs. This land was cultivated by slaves, or serfs

hardly better off than slaves; and these serfs I have shown to be probably the *bordarii* of Domesday Book. The "ut-land" [*out*-land, contrasted to *in*-land] or *upland*, as it is generally called, was that of which the lord was recognized as proprietor, but only to the extent of receiving certain dues and services, and exercising a certain degree of jurisdiction. Its inhabitants were freehold tenants, and it therefore came to be known as the *tenement lands*; these I have shown were probably the *villani* of Domesday Book. The upland, or tenement lands, were also called the *foreign** land, as being in a certain sense free and independent of the lord of the manor. Over the *demesne* he was *master*; over the tenement lands he was only *lord*. The inhabitants of the inland or *demesne* were, so to speak, members of his household; those of the upland or tenement lands came under his authority only in certain specified points.

Now it was to the upland, not to the inland, that the term sôc† was applied; that is, to the legal and special jurisdiction over freemen, not the irresponsible mastership over serfs and slaves. But I have shown that the inhabitants of the upland or tenement lands were the *villani* of Domesday Book; these were, therefore, within the sôc of the thegn, and were strictly *socmen*. I will go a step further, and anticipate a point which does not properly fall within the limits of this paper, by saying that because they lived within the sôc, they were called *socage* tenants.

It appears then, from the etymology of the word, that the *sochemanni* must have been people living within the sôc or jurisdiction of individual thegns, as contrasted with the slaves and cottagers upon their demesne lands. It follows that the *villani*, if they were, as I think is proved, the inhabitants of the uplands, members of organized village communities, were properly socmen, *provided their thegn possessed the franchise of sac and soc.* Under the fully developed manorial system all

*Extenta Manerii, 4 Edw. 1.
† In dominio aulæ sunt x bovata de hac terra. Reliqua est soca. *f.* 283*a*.

lords of manors possessed these franchises, and all inhabitants of the tenement lands became socmen, or, as the terms were then identical, socagers. But when the system was still in process of development, only those *villani* would be socmen whose thegns had obtained these franchises by special grant; and on the other hand there might be tenants living within the jurisdiction of a thegn, and thus properly socmen, who were not members of the organized village communities. There were therefore *villnai* who were not socmen, and there might be socmen who were not *villani*. In a register like Domesday Book it would be natural to enumerate a great class like the *villani*, which was found throughout England, under this, its special name, and that whether they were strictly socmen or not; while the term socmen would be reserved for those who were not *villani*, and yet who stood like these under the sôc of a lord or a manor.

It appears probable, therefore, that the *sochemanni* of Domesday Book were persons holding tracts of land independent of the organized village communities, but coming like the villagers under the jurisdiction of the thegn. We might, therefore, expect them to be a comparatively scattered and occasional class; and the record shows that as a matter of fact there was a great disparity in their position and protection. We find 2 *sochemanni* of 24 acres of arable land, and 4 of meadow; 14 of 9 acres; 12 of 40 acres; 5 of 20 acres; 1 of 1–2 hide; 3 of 1–2 hide, etc. Their position in the record varies also; sometimes they are enumerated with the other classes [2 *sochemanni*, 1 *villanus*, and 1 *bordarius*—25 *sochemanni* and 15 *villani*.] very rarely standing last. Sometimes they are put by themselves [5 *sochemanni* of 3 hides, and 35 *villani* and 20 *bordarii*.]. A very common expression is, "There belonged to this manor so many *sochemanni*." Occasionally a socman seems to rank almost as a thegn; as "in Nortun, 1 *sochemannus* with 81 acres of land, and 1 acre of meadow, and 1 *villanus* and 7 *bordarii*; and he was of a free man of Roger Bigod." Here we have

villani and *bordarii* under a socman, himself under a "free man," who was the vassal of the great lord Roger Bigod. Again, "7 *sochemanni* having 12 *villani* and 6 *bordarii*." Also, *sochemanni* holding lands "in demesne," like lords of the manor. Again, the introduction to the Ely Inquest proposes to ascertain how many *villani*, how many *cotarii*, how many slaves—then "how many free men, how many socmen."

The following is a fuller example of socmen from Cambridgshire, a manor held by one Guido:

[In the time of King Edward] "sixteen sochemanni held this land. Of these, 10 had 2 hides and 1–2 virgate* of the soca of St. Ethelred of Ely, of whom one could not sell his land, the other nine could sell to whom they wished, but the sôc of all remained to the church; and 6 others held one hide and 2 virgates of Count Algar, and could give or sell."

Of 24 socmen, "1 held under Edith the fair—all the others were socmen of King Edward."

We have thus ascertained the probable meaning of *sochemannus*, from its etymology, and found this to be supported by the facts as recorded in the survey. Both etymology and evidence go to show that this was a class in nearly the same social position with the *villani*, but not like them members of the village organizations; that they were an occasional and scattered body, and that they differed very widely from one another in wealth and position. This theory finds a strong support in a provision of the Laws of Edward the Confessor† by which in the Danalagu the "manbote" of the *sochemannus* and of the *villanus* is the same, while that of the "free man" is twice as much. A class like this, equal in rank to the members of the native organizations, but occasional, scattered, and differing very widely in standing and wealth, can be best explained by supposing an intrusion, or an invasion and occupation by the side of the old inhabitants.

* The virgate was 8 acres; the hide 4 virgates.

†Chap. XII.

Having considered the probable meaning of the term, and the way in which it is used in Domesday Book, let us consider the geographical argument, the one which led Lappenberg to so fruitful results in the case of the "free men." In what counties of England do we find socmen? and is there anything that distinguishes these counties from other parts of England?

1. With very trifling exceptions, the socmen are found exclusively to the north and east of Watling Street.

2. They are most numerous in Lincolnshire, and next to this in the counties adjoining—Nottinghamshire, Leicestershire and Norfolk. In the counties next to these they are in much smaller numbers. That is, they may be said to spread out from Lincolnshire south and west, over the other counties of the Danalagu.

3. In Lincolnshire, and in a less degree, in the adjoining counties, we find that the *sochen*, or detached places under the jurisdiction of the lord of the manor, are very numerous.

We might expect from this that the socmen would be found exclusively in these *sochen;* but,

4. Although these *sochen* almost always contain socmen, they do not always contain these; and on the other hand socmen are found in the manors themselves. This I shall attempt to explain presently; so far as it goes, it is a fact of some importance that socmen *prevail* in these *sochen*, even if they are not found in them universally and exclusively.

The facts here given lead of themselves to the theory which seems to me probable. Just as the *liberi homines* are found in the counties occupied by the Danes of Guthorm, so the counties in which the *sochemanni* most abound are precisely those in which the later settlements of Danes were principally made; we find the socmen most numerous exactly where we know that these Danes were most numerous. I can hardly resist the conclusion that the socmen were the descendants of these Danes. When they conquered the country, they did not disturb the organized village communities of the English, but—

there being plenty of unoccupied land—partly public land, partly the waste of the several manors—assigned tracts to their followers from this. The leaders became thegns, and under their *soc* were two classes, equal in rank—the native *villani*, and the *sochemanni*, the rank and file of their own army. This will explain the irregularity and disparity in the condition of the socmen.*

The theory that the socmen were the descendents of Danish settlers, finds confirmation in a law of King Cnut, which fixes the *heriot*, that is, "the military equipment of a vassal, which on his death reverted to the lord" [Stubbs.] After giving that of the three grades of nobility, the Earl, the King's thegn and the medial thegn, it goes on: "and the heriot of a King's thegn among the Danes, who has his soken, four pounds."† Now we have found *soken*, that is, detached places under the jurisdiction of a thegn or manor, to be very abundant in the counties where the Danes were found; and the passage just quoted proves some peculiar and special relation of the sesoken to Danish thegns.

I have now shown: 1. From the meaning of the word *soc*, and its use as contrasted with the "inland" or demesne, that the *sochemanni* were probably a somewhat scattered and irregular class, under the jurisdiction of the several thegns. 2, From the records of Domesday Book, that they were actually a scattered and irregular class, under the authority of individual thegns, nobles and great persons. 3. From the Laws of Edward the Confessor, that their rank was the same as that of the villani, who were the native English peasantry, and were likewise under the jurisdiction of their several thegns. 4. That the existence of such a local and exceptional class as the socmen can be best explained by supposing an intrusion from some foreign country, which introduced an irregular body by

* When the Danish counties were recovered by the English Kings, the Danish thegns were not displaced, and says Palgrave, "as late as the reign of Ethelred, we can trace their existence as a privileged community, distinct from the kingdom in which they were included." A. S., p. 97.

† Stubbs, Select Charters, p. 73.

the side of the compact and organized one. 5. That we know as a fact that there was such an intrusion of Danes, and that the intruders had their centre and seat precisely in those counties where we find the socmen. 6. That the Danish origin of the socmen is further supported by the passage in the laws of King Cnut, which speak of Danish thegns who have their *soken*, as well as the law of Edward the Confessor, which speaks of *sokemanni* in the Danalagu, as contrasted with the rest of England.

It does not follow from these arguments that all the *sochemanni* registered in Domesday Book were of Danish origin, or that all of Danish origin were *sochemanni* or *liberi homines.* The point to be explained is the existence of these two great classes in a certain group of counties, by the side of the two classes of *villani* and *bordarii*, which are found everywhere. This circumstance is easiest explained by supposing a prevailingly Danish origin. But the time when Domesday Book was compiled, was a time of rapid and sweeping changes; the Conquest must have acted powerfully in breaking up the old organizations and mixing together the several classes of population. After this time we find no mention of *bordarii*; the term *villanus* gradually lost its dignity and became equivalent to "serf;" while *sochemanni* were no longer confined to the Danish counties, but the name came in time to be applied to the body of the free peasantry in all parts of England.

ON THE PLACE OF THE INDIAN LANGUAGES IN THE STUDY OF ETHNOLOGY.*

BY PROF. J. B. FEULING PH. D.
Professor of Comparative Philology in the University of Wisconsin.

Physical ethnology has shown that all the different tribes of Indians constitute but one race from the Arctic Ocean to Cape Horn. But *physical* evidence of race is as incomplete without the confirmation of *linguistic* evidence, as is the latter without the former. Race and language run parallel only in prehistoric times, or at the very dawn of history. The connection therefore between physical ethnology and linguistic ethnology consists in giving mutual advice and suggestions. Accommodation and mutual concessions should not enter here.

As languages change more rapidly than races, it seems often impossible, even in languages whose current we are able to ascend beyond the dawn of tradition, to gather up the connecting links between language and race, or to point out, when, where or how they separated. Besides we must be careful in drawing conclusions from facts, which may be the "result of accident." All this must be borne in mind by the student the more carefully, as the philological details are very scanty and insufficient. Although the affinity between the Indian languages, as determined by their *vocabularies*, is not less real than that inferred from the analogies of their *grammatical forms*, it would not be a conclusive evidence for the original unity of the various tribes, because we have no historical documents, and tradition is silent as to the existence of a "specific centre." If we had documentary evidence of the

* The loss, by accident, of this paper, as origiually presented, has necessitated its publication in the form of a brief abstract.

intermediate dialects, we would be able, perhaps, to give a complete account for the great dissimilarity of Indian languages. For the present the question of their mutual relation and possible transmutation from a common prototype will best be cleared up by a careful systematic study of the actually existing dialects.

Then followed a critical account of what had been accomplished in this field by eminent scholars, e. g. Gallatin, G. Gibbs, E. G. Squier, Lewis H. Morgan, Dr. Brinton, J. Shea, Dr. J. H. Trumbull and others; the materials and theories of Duponceau, Heckewelder, Schoolcraft, etc. are worthless.

Besides the importance of the Indian languages in an ethnological view, the possibility of an approach through them to the great problem of the origin of language was pointed out.

Mr. F. showed the duty of the Academy towards assisting to secure from destruction the languages of the Indians of America and to facilitate the work of the linguistic scholar by collecting materials, as books, etc. In collecting materials special attention should be paid to those tribes (about 26), which, since our first knowledge of them (a. 1670), lived within or passed through the State of Wisconsin. Attention was called to Col. George Gibbs' "Instructions for research relative to the Ethnology and Philology of America" * and to the hints given by Hon. J. H. Trumbull in a paper "On the true method of studying the American Languages," read before the American Philological Association, at Poughkeepsie, 1869.†

There are other monuments, besides languages, which claim our attention in the elucidation of the ethnological problems involved in the past history of America,—monuments left by a people, whose very name has vanished. "Mound-Builders" is a conventional name. Geology, and the extreme

* Smithsonian Miscellaneous Collections, (Vol. vii., Art. xi.)

† This valuable paper has been published since in the "Transactions of the American Philol. Association," (Vol. I, Art. iv.)

decay in which skeletons of Mound-builders are found, have assisted in ascertaining that the mounds are of high antiquity, which is also attested by their relation to forest-growths. It is impossible to give any fixed data; it is, however, safe to say that 2000 years at least have passed since the disappearance of a people which were not the ancestors of the wild Indians, as it is commonly believed. For many reasons (mining operations, etc.) the Mound-Builders must have been stationary and agricultural in their habits. We may never be able to answer the question, Who were these Mound-Builders or whence did they come? Still it is not impossible to find the thread which connects these ancient monuments and their scanty relics with those of Central America and, perhaps, with more distant quarters, after their extent and contents, as well as their general character, have been better understood.

We have a meritorious work by Dr. I. A. Lapham, "The Antiquities of Wisconsin" (Smithsonian Contributions to Knowledge, Vol. vii), which has however not made unnecessary further exploration and study. There remain a great many mounds unnoticed and unexplored, which may lead to more important results. It is hoped that these mysterious antiquities within our State will be saved as sacred mementos of the past from oblivion and destruction.

There is hardly a farmhouse in Wisconsin, where some kind of relics, as stone-implements, etc., are not either kept as a curiosities or thrown aside like so many other "useless things." Sufficient interest should be awakened among the people to care for the preservation of such relics or to forward them generously to some place of collection.*

Let us mark the words of William D. Whitney, safest and surest of guides: "Our national duty and honor are peculiarly concerned in this matter of the study of aboriginal

*Mr. F. S. Perkins of Burlington, Wis., has the largest collection of stone implements, beside that of the Smithsonian Institute, and he spares neither time nor money, in order to make new additions to his valuable collection. We hope that the State may be able to procure this collection some day, as the beginning of a State Museum of American (Wisconsin) Antiquities.

American languages, as the most fertile and important branch of American archæology. Europeans accuse us, with too much reason, of indifference and inefficiency with regard to preserving memorials of the races whom we have dispossessed and are dispossessing, and to promoting a thorough comprehension of their history. Indian scholars, and associations which devote themselves to gathering together and making public linguistic and other archaeological materials for construction of the proper ethnology of the continent, are far rarer than they should be among us." "So much the more reason have we to be grateful to the few who are endeavoring to make up our deficiencies by self-prompted study, and especially to those self-denying men who, under circumstances of no small difficulty, are or have been devoting themselves to the work of collecting and giving to the world original materials."

M.

PROCEEDINGS.

[Condensed from the BULLETIN.]

PROCEEDINGS OF THE CONVENTION CALLED TO ORGANIZE THE ACADEMY.

Pursuant to a call of citizens, issued February 1, 1870, a large meeting of scientific, literary and other prominent men of the State was convened in the State Agricultural Rooms, at Madison, on the 16th of February, for the purpose of organizing an association that should be devoted to original research and investigation.

The convention was called to order by Dr. J. W. Hoyt, who read the call, and nominated Hon. W. P. Lynde as temporary chairman.

On assuming the chair, Senator Lynde declared his hearty approval of the objects of the meeting in a neat and eloquent speech.

Prof. Foye, of Lawrence University, was appointed temporary Secretary.

On motion, the President appointed Dr. R. Z. Mason, Dr. Joseph Hobbins, and Rev. Samuel Fallows, to nominate permanent officers of the Convention.

The committee made the following nominations:

President—Gov. L. Fairchild.
Vice Presidents—Ex-Gov. N. Dewey, and Dr. G. M. Steele.
Secretaries—Dr. I. A. Lapham and Prof. T. C. Chamberlin.

Dr. Hoyt said:

He regretted that, while his Excellency, the Governor, heartily approved of the objects of the Convention and had expressed his readiness to preside at its sessions, circumstances would necessitate his absence for a time. He moved, therefor, that Ex-Governor Dewey, first on the list of Vice-Presidents, be requested to take the Chair.

On assuming the Chair, Gov. Dewey said:

He thanked the Convention for the honor conferred. Although not claiming to be a man of science, he felt deep interest in every movement that promised to aid in the advancement of Wisconsin. He had long recognized the importance of some institution specially devoted to scientific investigation, and was heartily glad that so large a number of the prominent men of the state had shown their appreciation of the efforts in that direction by attendance upon the Convention. There was much that greatly needed to be done, and there were competent men ready to undertake its accomplishment. The work and workers would at all times have his cordial support, and until the return of Gov. Fairchild, who had very properly been chosen President of the Convention, he would have pleasure in serving them to the best of his ability.

Judge J. G. Knapp offered the following resolution:

Resolved, that we do organize an association under the name of "Wisconsin Academy of Sciences, Arts, and Letters."

Dr. Hoyt stated that,

Inasmuch as several of the gentlemen who had expressed cordial approval of the proposition to organize such an Academy as was contemplated by the resolution just offered, were unable to attend the Convention, it seemed proper that their views as presented in the communications he had received from them, although probably not written with reference to such use, should be laid before the Convention. Accordingly, with the approval of its members, he would proceed to read at least such portions of some of them as were likely to be of most interest.

Letters were accordingly read from the following gentlemen:

Hon. John G. McMynn, late Superintendent of Public Instruction; Prof. R. G. Hinsdale, Racine College; Prof. J. J. Bushnell, Beloit College; Lt. Gen. Wyman Spooner; Hon. Asahel Finch, Milwaukee; Prof. W. Porter, Beloit College; Rollin A. Smith, Esq., Fond du Lac; Hon. W. W. Field, Boscobel; J. Lawler, Esq., Prairie du Chien; Hon. D. J. Pulling, Circuit Judge, Beaver Dam; President W. C. Whitford, Milton College; Hon. Anthony Van Wyck, Milwaukee; Professor A. K. Johnston, Mineral Point; Hon. M. K. Young, Glen Haven; Hon. John E. Thomas, Sheboygan Falls; J. H. Evans, Esq., Platteville; President Lewis O. Thompson, Watertown; Hon. James H. Earnest, Shullsburg; Hon. Tim. O. Howe, U. S Senate; Hon. H. S. Baird, Green Bay; Dr. J. L. Jenckes, Hazel Green; Dr. R. B. Treat, Janesville; Hon. J. H. Rountree, Platteville; Hon. G. W. Cate, Circuit Judge, Amherst; Prof. S. S. Sherman, Milwaukee; Hon. David W. Jones, Mineral Point.

The resolution was then unanimously adopted.

Dr. Hoyt moved the appointment, by the President, of a committee of five members to prepare and submit to the Convention a plan of organization for the Academy.

The chair appointed Dr. J. W. Hoyt, of Madison, President G. M. Steele, of Lawrence University, President A. L. Chapin, of Beloit College, Dr. Solon Marks, of Milwaukee, and Hon. J. T. Mills, of Lancaster, as said committee, with instructions to report, if possible, at the ensuing session.

Adjourned to 7½ o'clock, P. M.

The Convention met pursuant to adjournment.

On behalf of the committee on a plan of organization for the Academy, Dr. Hoyt reported a Constitution, which, on motion, was unanimously adopted.

[For Constitution see BULLETIN No. 1.]

After the adoption and signing of the constitution, on motion of Dr. E. B. Wolcott, of Milwaukee, the President was instructed to appoint a committee of five to nominate a President, a General Secretary, and a Treasurer for the Academy. The chair appointed as such committee, Dr. E. B. Wolcott, Geo. P. Delaplaine, President G. M. Steele, President A. L. Chapin and Professor T. C. Chamberlin.

The committee retired, and in due time returned and reported the following nominations:

For President—Dr. J. W. Hoyt.
For General Secretary—Dr. I. A. Lapham.
For Treasurer—Geo. P. Delaplaine.

The report of the committee was adopted.

The President of the Convention having, on motion, appointed

a committee consisting of Dr. E. B. Wolcott and Dr. Joseph Hobbins to notify the said officers of the Academy of their election, and to conduct the President thereof to the chair,

The Convention dissolved.

FIRST MEETING OF THE ACADEMY.

Pursuant to call, made at the instant of the dissolution of the convention of citizens met to organize the same, the Wisconsin Academy of Sciences, Arts and Letters convened in the place of said Convention at 9 o'clock P. M. of same day (Feb. 16.)

On assuming the chair, President Hoyt said:

While he felt highly honored by the unanimous expression of the wish of its members that he should preside over the Institution, in the formation of which all gentlemen present had shared, and was sincerely grateful to them for their confidence, he was profoundly sensible of the grave responsibilities involved in an acceptance of the position. Pioneer work was laborious in whatever field, but especially so in the founding and upbuilding of institutions devoted to a work of which the body of the people could hardly be expected to have a just appreciation. Academics devoted to original research were the forerunners of a higher civilization. It was rarely that their services were recognized at their true value at the time, but without them the world would make but slow progress. He was glad that the proposition to found such an institution in Wisconsin had been received with warm approbation, and desired to congratulate the members of the Academy that it had pleased them to adopt a plan of organization so broad and comprehensive as to include every class of searchers after knowledge. The Convention had manifested an intelligence, unanimity and enthusiasm worthy of the cause sought to be advanced, and it now only remained to push on the work with vigor and resolution. Each member must consider himself a committee responsible for the advancement of the Academy's interests in his own locality as well as throughout the range of his acquaintance, and by every means in his power. Should this be the case, the organization of the Wisconsin Academy of Sciences, Arts and Letters would be notable in the future as the inauguration of a new era in the history of the State. He accepted the responsible and laborious position of President, in the belief that he would not be denied the hearty co-operation he so earnestly craved, and with the purpose to do everything in his power to make the Academy successful in every respect and in an eminent degree.

At the conclusion of the President's remarks, it was moved by Ex. Gov. Dewey that the Academy proceed at once to the election of a Director of the Museum, a Librarian, and of the constitutional departmental officers for the Department of the Sciences; and that, in the absence of By-Laws regulating the mode of procedure, such election be *viva voce*, on nominations made by any member of the Academy. The motion prevailed, and the following officers were duly elected:

Director of the Museum—Wm. Dudley, Esq.
Librarian—Hon. J. G. Knapp.
Vice President of the Department of Sciences, and ex-officio a Vice President of the Academy—Dr. P. R. Hoy.
Secretary of the Department of the Sciences—Col. S. V. Shipman.
Counsellors for the Department—Prof. T. C. Chamberlin, Dr. E. B. Wolcott, Dr. R. Z. Mason.

The Treasurer was authorized to purchase the necessary books of record.

The President having given notice that a meeting of the General Council would be held in this place at 9 o'clock on the following morning, for the purpose of adopting By-Laws for the government of the institution, the Academy adjourned *sine die.*

FIRST MEETING OF THE GENERAL COUNCIL.

Adoption of By-Laws.

The General Council of the Wisconsin Academy of Sciences, Arts and Letters, met pursuant to the call of the President, in the State Agricultural Rooms, at 9 o'clock A. M., of February 17, 1870.

Present—Messrs. J. W. Hoyt, President, in the Chair, P. R. Hoy, T. C. Pound, Geo. P. Delaplaine, Wm. Dudley, J. G. Knapp, T. C. Chamberlin, R. Z. Mason, S. V. Shipman and I. A. Lapham.

After due consideration, the Council adopted the following By-Laws:

[For By-Laws, see BULLETIN No. 1.]

On motion, the Chair appointed the following Standing Committees:

On Nominations—Dr. G. M. Steele, Dr. Solon Marks and Prof. Jas. H. Eaton.
On Papers Presented to the Academy—Dr. A. L. Chapin, Dr. P. A. Chadbourne and Dr. I. A. Lapham.
On Finance—Hon. Nelson Dewey, Hon. Alexander Mitchell and Hon. Wm. E. Smith.
On the Museum—Dr. P. R. Hoy, Charles Preusser and John Murrish.
On Library—Hon. Lyman C. Draper, Dr. Joseph Hobbins and Hon. Wm. Pitt Lynde.

The Council adjourned, "subject to call of the President."

SECOND MEETING OF THE ACADEMY.

First Session—Executive Proceedings.

The Second Regular Meeting of the Academy was held in the rooms of the State Agricultural Society, at Madison, commencing on Tuesday, July 19; fifteen members being present. The president, Dr. J. W. Hoyt, in the chair.

Letters were read from several members unable to be present.

Donations for the Museum were presented as follows:

A wolverine (*Gulo luscus*, Sabine), killed in Juneau county, and presented by Hon. J. T. Kingston, of Necedah; and a lynx (L. *Canadensis*, Rafinesque), killed near Madison, and presented by Jacob Seiler of that city; which, on motion, were accepted, with the thanks of the Academy.

Specimens of the rocks, minerals, ores, clay, etc., from Garrisonville, Sauk county, presented by Mrs. Dr. Taylor of that place, were examined and commented upon.

The President submitted an informal report of what had been done since the date of the last meeting:

A liberal charter had been granted by the legislature, at its late session, with authority to occupy apartments in the capitol, if not inconsistent with the public business of the State; a law had been passed providing for a topographical survey of the lead district, the specimens of minerals, rocks and fossils collected being required by law to be deposited with the Academy; the publication of a Bulletin had been commenced, in which it was proposed to include such of the proceedings as seemed of sufficient importance; and favorable responses, received from all parts of the State, gave encouragement to hope that the Academy would be sustained, and become an institution of permanent usefulness.

He then laid before the Academy the text of the Charter granted by the State.

[See No. 1 of the BULLETIN, p. 17; also General Laws of Wisconsin, 1870.]

The following persons were admitted to membership:

LIFE MEMBERS:—Hon. J. E. Thomas, Sheboygan Falls; N. S. Green, Esq., Milford; Hon. J. I. Case, Racine; Hon. Simeon Mills, Madison; Jas. L. Hill, Esq., Madison; Hon. J. G. Thorp, Madison; John H. Van Dyck, Esq., Milwaukee; Jas. J. Hagerman, Esq., Milwaukee.

ANNUAL MEMBERS:—Rt. Rev. W. E. Armitage, Milwaukee; Pres. W. C. Whitford, Milton; Prof. T. H. Little, Blind Asylum, Janesville; Samuel P. Cary, Esq., Oshkosh; Rev. Albert O. Wright, Waterloo; Mr. Cyrus T. Hawley, Milwaukee; Prof. John E. Davies, State University, Madison; Rev. J. B. Pradt, Madison; Capt. W. A. De La Matyr, Mazomanie; Eugene R. Leland, Esq., Milwaukee; Alex. Provis, Esq., Lancaster; Mr. Jas. J. Cammack, Madison; Elisha Burdick, Esq., Madison; John R. Baltzel, Esq., Madison; Prof. R. G. Hinsdale, Racine College; Rev. J. C. C. Clarke, Madison; Hon. J. T. Kingston, Necedah; Dr. Moses Barrett, Waukesha.

On motion of J. G. Knapp, it was

Resolved, That the fees for members for life be set apart as a permanent endowment fund, to be invested in Wisconsin State bonds, or other equally safe securities, and that the proceeds of said fund, only, be used for the general purposes of the Academy.

A committee was appointed to apply to the Governor for the assignment of apartments in the capitol for the proper preservation of such scientific specimens, books, and other collections as may become the property of the Academy.

The President and Secretary were authorized to continue, from time to time, the publication of the BULLETIN.

Adjourned till 9 o'clock of the following morning.

Second Session—Communications.

The Academy met pursuant to adjournment, for the reading and discussion of papers. There were present several additional members; the President in the Chair.

The following are the titles of papers presented and discussed during the morning session, with the leading ideas contained:

1. On the Classification of the Sciences. By Rev. Albert O. Wright, of Waterloo. Mr. Wright said in substance, that

Every science has two aspects, a concrete and an abstract. The logical order is from the abstract to the concrete. But the order of discovery is first the practice of an art, then the gathering of facts for the concrete science, then ordering the principles for the abstract science. These last have an order among themselves, which the concrete sciences and the arts follow. Rising from the lower to the higher, this order of the abstract sciences, with their dependent sub-sciences, concrete sciences and practical arts is; Mathematics, Astronomy, Physics, Chemistry, Biology, Psychology, Sociology, Theology. Each of these sciences has a principle underlying it which we have discovered or hope to discover; and each science uses its own laws and the laws of all below it, but not of those above it; and no science can be completed until the one next below it is. Commencing with the science of *Abstract Relations*, by adding one law, we have the science of *celestial phenomena*; by adding again one law, we have the science of *terrestrial phenomena*; again adding one law, we have the science of *chemical affinities*; at the next step we enter the domain of *life*, at the next that of *mind*, at the next that of *mind in masses*; and by the last and greatest step we rise to *the Supreme of the Universe*.

2. On the importance of more attention to the Preservation and culture of Forest Trees in Wisconsin. By Mr. P. Engelmann, Secretary of the Natural History Society, Milwaukee.

The author commented on the rapid destruction of the forests in the State, now going on with a geometrical ratio of progression that must, within comparatively a very few years, bring not only a scarcity of timber, notwithstanding the munificent provisions of Nature, but likewise important and unfavorable changes in the climate of the State. He cited the governments of the Old World as examples of the provident care induced by the lessons of experience, and also alluded to the wise legislative action of some of the neighboring States of the Union in providing for even, the planting of forests where they have not existed heretofore. This seemed to be a matter of sufficient importance to receive the present, and earnest consideration of the Academy and of the Legislature of the State.

3. On the Coniferæ of the Rocky Mountains, and their adaptation to the Soil and Climate of Wisconsin. By J. G. Knapp, Esq., Madison.

[Published in Transactions, p. 117.]

The Academy adjourned until 2 o'clock P. M.

Third Session—Communications.

The Academy met, pursuant to adjournment, for the reading and discussion of the following papers:

4. On the Origin of the Potsdam Sandstone. By John Murrish, State Commissioner for the Survey of the Lead Regions.

5. On the Importance and Practicability of a Unit of Force in Physics that shall be of Universal Application. By Professor John E. Davies, of the Wisconsin State University.

6. Abstract of a Paper On the Fauna of Lake Michigan off Racine. By Dr. P. R. Hoy, of Racine.

[Published in full in the Transactions, p. 98.]

7. On the Age of the Quartzite of Baraboo. By Dr. I. A. Lapham, of Milwaukee.

In this paper, Dr. Lapham described the geological character of the country about Devil's Lake, Baraboo, and presented reasons for concluding that the peculiar formations there should be attributed to the action of water.

8. On the Formation of Certain New Compounds of Manganese. By Professor James H. Eaton, of Beloit College.

In this paper, Professor Eaton gave an account of some exceedingly interesting original investigations into the chemical properties of manganese, with details of the steps taken in the formation of some new compounds analagous to the yellow and red prussiates of iron, and observations upon the physical and chemical properties of such compounds.

Adjourned till 8 o'clock P. M.

Fourth and Final Session.

The evening session was occupied mainly with an informal discussion of various questions pertaining to the future of the Academy, and the issuing of certificates of membership. His Excellency, Governor Fairchild, was present, and took occasion to express cordial sympathy with the important objects of the Academy and to congratulate its members upon the success of the present meeting.

The Academy then adjourned *sine die.*

THIRD MEETING OF THE ACADEMY.

First Session.

The third regular meeting of the Academy was convened in the City Hall, at Milwaukee, on Tuesday, the 28th of September, at 2 o'clock P. M.; the President, Dr. J. W. Hoyt, in the chair.

Owing to an error in the published notices, which named the 29th as the date of the meeting, but few members were present. And, accordingly, on motion of Dr. R. Z. Mason, an adjournment was taken until the following day, at 2 o'clock P. M.

Second Session—Executive Proceedings.

The Academy met pursuant to adjournment, and, in the absence of the President, detained by pressing duties connected with the State Industrial Exhibition, was called to order by Dr. A. Lapham, General Secretary; upon whose motion Dr. R. Z. ason was elected temporary chairman.

Rev. C. Caverno, of Lake Mills, and Messrs. G. W. Chapman and Amasa J. Finch, of Milwaukee, were put in nomination for membership, and, upon motion, were elected without dissent.

The following papers were read and discussed.

1. The Metamorphic Rocks in the town of Portland, Dodge county. By A. O. Wright, of Waterloo.

He gave a description of the position and appearance of the rock formations in question. They were fractured, and presented, to his eye, indications of having been cracked by some subterranean force. The force that acted below sent up through the crevices steam and heat to the extent of transforming the sandstone into quartzite, and, in veins, pure quartz. He also discovered here traces of the glacial period.

Dr. Lapham said this region had been discovered many years ago by Dr. Thayer; that it was also mentioned in Owen's and Percival's report, wherein it was stated that the quartzite is modified sandstone of older formation.

Dr. Mason said, as the object of the Academy is investigation, he thought it would be proper to invite some one of experience to go to this place and gather facts, and give, as far as can be ascertained, the geological appearance, with the theory of their causes.

On motion, Prof. Eaton was selected as a committee to make the investigations, and afterwards, Prof. Chamberlin was added to the committee.

2. The Metamorphic Rocks at Devil's Lake. By A. O. Wright, of Waterloo.

3. Some Observations upon the Fauna of Mammoth Cave. By P. Engelmann, Esq., Secretary of the German Natural History Society, Milwaukee.

Mr. Engelmann's paper embraced an account of a late visit to Mammoth Cave, with descriptions of various curious fishes found in its waters, specimens of which were displayed before the Academy.

At the conclusion of the readings and discussions, Prof. T. C. Chamberlin, of the State Normal School at Whitewater, after some remarks upon the importance of systematic work, offered the following:

Resolved, That the Secretary be requested to present an outline of the scientific investigations that have been made in Wisconsin, and that he indicate what lines of investigation it is most desirable to pursue, and that he be empowered to assign such portion of its work to the various members of the Academy as may seem most desirable.

Which, on motion, was adopted.

Adjourned, to meet again at 9 o'clock A. M. to-morrow.

Second Session—Papers and Discussions.

The Academy met pursuant to adjournment, Dr. R. Z. Mason in the chair.

Papers were presented as follows:

4. On the Isothermal lines of the Northwest. By J. G. Knapp, Esq., of Madison.

This paper called attention to the climatic peculiarities of Wisconsin, as illustrated by meteorological charts of Dr. J. W. Hoyt and Dr. I. A. Lapham, and sought to explain their relation to the actual distribution of vegetation, and to the agricultural and horticultural capabilities of the State.

5. On the Nebular Hypothesis in Astronomy. By R. Z. Mason, LL. D., of Appleton.

The author of this paper admitted that there was no conclusive evidence that the process of world-formation from nebulous matter was actually going on at the present time. There were, however, strong reasons in support of the nebular hypothesis; the first being based on the constancy of the "moment of inertia," the second on the identity of composition of the earth and sun as shown by the spectroscope, and the third on the correlation of forces.

Adjourned until 2 o'clock, P. M.

Third Session.

The Academy met pursuant to adjournment at 2 o'clock, P. M. Dr. R. Z. Mason in the chair.

The reading and discussion of papers were then resumed.

6. The Mineral Well at Waterloo, Wisconsin. By A. O. Wright.

[Published in the Transactions, p. 151.]

7. On the Classification of Plants. By Dr. I. A. Lapham, of Milwaukee.

[Published in the Transactions, p. 102.]

Mr. Goodwin Lowrie, of Helena, and Mr. Joseph S. Carr, of Neilsville, were elected members.

Judge Knapp gave notice of an amendment to the by-law requiring meetings of the Academy to be held during the annual exhibitions of the State Agricultural Society.

An invitation from the directors of the Association for Natural History, to visit their museum, in the building of the English and German Academy, was received and accepted with thanks.

Adjourned *sine die.*

FIRST ANNUAL MEETING OF THE ACADEMY.

First Session.

The fourth regular and first annual meeting of the Academy was convened in the rooms of the State Agricultural Society, at Madison, commencing on the evening of February 14. A large number of gentlemen were present from all parts of the State.

The President, Dr. J. W. Hoyt, in the chair.

Dr. I. A. Lapham, of Milwaukee, General Secretary of the Academy, being absent, Prof. John E. Davies of the State University, was elected Secretary *pro tem.*

Donations to the Museum of the Academy were received from ex-Governor L. J. Farwell, of Chicago.

The President of the Academy, Dr. Hoyt, gave

A general statement of work that had been done since the last meeting, and recommended the immediate organizationn of the proposed departments of Social Science, of the Arts, and of Letters. He also reported that the Wisconsin State Agricultural Society had passed resolutions expressive of their interest in the work undertaken by the Academy, and tendering the use of their rooms for its meetings and the preservation of its collections, and that said Society had, moreover, amended their constitution so as to make the President and General Secretary of the Academy members ex-officio of the Executive Board of the Society.

Which generous action was recognized by a vote of thanks.

The Treasurer, George P. Delaplaine, reported as follows:

RECEIPTS.

To fees from thirty-four Annual Memberships	$340 00
To fees from six Life Memberships	600 00
Total receipts	$40

EXPENDITURES.

By sundry disbursements per order of the President, as per vouchers herewith submitted	$156 70
Balance in the treasury	$783 30

The report was referred to the Finance Committee, by whom it was examined and reported back with their approval.

The committee on the purchase of Mr. Deininger's Natural History Collection, were, at their own request, allowed more time for examination.

The names of several new members were proposed, and referred to the Committee on Nominations.

A paper was then read by A. J. Finch, Esq., of Milwaukee,

1. On Metallic Veins and the Deposition of Minerals.

The object of this paper was to refute the Wernerian theory, and to prove that metals found *in situ* were deposited from their gases originating in the interior of the earth.

On motion of J. G. Knapp, the following resolutions were adopted.

Resolved, 1st. That active members of the Academy be each requested to report to the President or Secretary of the Department of the Sciences, and designate the section of the Department to which he will choose to belong.

2d. That if any member be present who does not desire to connect himself with the Department of the Sciences in any of its sections, he be requested to report to the General Secretary of the Academy, and name the Department to which he desires to be attached.

3d. So soon as the members shall have designated the Department or Sections to which they desire to belong, such Departments and Sections shall meet together and assign to the members thereof their respective work.

Adjourned until 9 o'clock of the following morning.

Second Session.

The Academy met pursuant to adjournment. The President in the chair.

Donations of specimens of copper, iron, lead and graphite were made to the Museum of the Academy by Hon. J. Murrish, which were accepted with a vote of thanks.

On the recommendation of the Committee on Nominations, the following gentlemen were elected members of the Academy:

CORRESPONDING MEMBERS.—Prof. Ezra S. Carr, M. D., LL. D., of the University of California, Oakland, Cal.; Hon. J. Wingate Thornton, of Boston, Mass.

ANNUAL MEMBERS.—Prof. R. Irving, E. M., Prof. of Geology in the University of Wisconsin; Maj. W. J. Nicodemus, U. S. A., Prof. of Military and Civil Engineering in the University of Wisconsin; Daniel S. Durrie, Esq., Librarian of the State Historical Society, Madison, Wis.; Hon. J. A. Bate, Chippewa Falls, Wis.; Prof. F. W. Woodward, Eau Claire, Wis.; Oliver Arey, Prest. State Normal School, Whitewater, Wis.

The following papers were then read and discussed:

2. On the Geology of the region about Devil's Lake, Sauk county, Wisconsin; being a report of observations made at the request of the Academy. By Prof. James H. Eaton, of Beloit College.

[Published in full in the Transactions, p. 124.]

3. On the Relations between Social and Moral Science. By Rev. Charles Caverno, of Lake Mills.

The leading ideas were these:

Whatever relates to the development and improvement of individual man or society will fall under the purview of Social Science. Let Moral Science be taken to be that which concerns itself with the sphere of right and wrong, with obligation, with the sense of *ought* in reference to human actions. It is the object of this paper to show the mutual dependence of these two sciences.

First, the dependence of Social upon Moral Science. To show men the better way, and induce them to walk in it, these are the great end of Social Science. To effect this last, there is no leverage upon humanity like the sense of right. When a new social principle is discovered and its value ascertained, then will come the question of its enforcement in society. But the chances are that it will not fall into place in society with its mere enunciation. It will have privilege and prejudice and custom, perhaps appetite and passion, to combat. To overcome these, it will have to establish itself in the forum of *the right*, with the conviction once firmly established that a thing *ought* to be done, it holds men irresistibly to it until it is done. There is no such might of enforcement in any other department of man's nature. It will be well for this new Social Science if in does not discard this fundamental truth and seek to attain its objects on the basis of and of the great fallacies which have led European reformers into such pitiful failures in the past.

If, now, we turn to the other side of the subject we shall find the dependence of Moral upon Social Science no less certain and considerable. The *ought* in many a subject is struggling up to the horizon, but cannot yet be seen. All the conditions upon which it depends are not mastered and systematized. What ought to be done will depend in many cases upon the effect which courses of action will have. Moral Science, in strictness, is no investigator or experimenter. It comes in with the power of moral obligation on the known and determined. Not so of Social Science. Society, in its advancement, is constantly brought in contact with questions in which the effect of any proposed method of action is problematical. The race has hitherto had scarcely any other way of solving such questions than by blundering in actual experiment through all possible evil courses to that one, which in the end, has shown itself to be good and right. Social Science proposes to take up such questions to see if it be not possible to avoid much of this sad experience by trying these questions beforehand, in tribunals removed as far as possible from human prejudice and party feeling, by the light of the already accumulated stock of human experience, by actual present investigation and experiment, and before the prophetic power of sound philosophy. When such investigations shall have been had, if the conclusions arrived at by Social Science may not be considered as established in the forum of right absolutely, *this* will be established—that it will be right to experiment in a direction so indicated rather than in another.

And when, after due examination had of all the elements that pertain to a matter, Social Science shall have reached an ultimate judgment, let it hand it over to Moral Science to be enforced by the binding power of moral obligation.

Adjourned to 2 o'clock P. M.

Third Session.

The Academy met pursuant to adjournment. The President in the chair.

Reading and discussion of papers resumed.

4. The Mammalia of Wisconsin. By Dr. P. R. Hoy, of Racine.

The Doctor said that the Elk existed in Wisconsin in 1863, but is now probably extinct The moose still exists in numbers. The last buffalo was killed in 1832. The antelope was once in Wisconsin—at the time of Hennepin's voyage. The musk-ox, the mastodon and the mammoth once existed here. The panther will soon disappear. It will be a

long time before the beaver will be exterminated. The otter will be retained longer. The deer will soon be exterminated. The last wild turkey was killed in '46, at which date a flock was killed in Racine.

5. On the climatic Relations of the Flora of Wisconsin. By Hon. J. G. Knapp, of Madison.

6. On the Results of Recent Investigations in the Lead Regions of Wisconsin. By J. Murrish, State Commissioner.

In entering upon the survey of the lead district, he found that, while there were conflicting opinions among miners in reference to the origin and nature of the fissures in connection with which ore deposits were found, they were nevertheless all agreed on this point, that there is a strong tendency in these fissures to an east and west direction.

They also recognized the fact that these so-called east and west fissures were occasionally intersected by another set of fissures at right angles, thereby presenting the familiar feature of mineral strata noticed in all mining regions,

In examinining into these facts to satisfy himself in reference to their correctness, he had noticed, in looking over the various mines which had been opened, that, while the different mineral ranges and mining centers were separated from each other by a space of barren ground, there was nevertheless a grouping of t ese ranges or mining centers on the east and west direction.

Further observation proves that they were confined to certain belts of land having an east and west bearing. For instance, if we commence in town six, with what mining there is done in the town of Fennimore, in Grant county, and extend east with a strip of land three or four miles wide through a large portion of that county and the whole of Iowa county to Blue Mounds, in Dane county, we shall include in that strip all the mines of Fennimore, Wingville, Dodgeville, Ridgeway, Porter's Grove and Blue Mounds, giving us a belt of land through town six for a distance of over fifty miles.

If we extend our observations south from this belt to Mineral Point, we shall find ourselves on the center of a parallel belt, extending east and west from that place. If from thence to Platteville, in Grant county, on the third. If from thence to Hazel Green, we shall find ourselves on the fourth, all having about the same eastern and western extension. The lead district thus naturally divides itself into four distinct belts, conforming evidently to underlying causes, that have given origin to these peculiar phenomena.

But, striking as the evidences of the action of underlying physical forces along these and west belts are, he was disposed, nevertheless, to regard them as subordinate to a stronger line of forces that have acted in a north and south direction, across which these belts are found at right angles. If, for example, we draw two lines from the eastern and western boundaries of the lead district, north and south, through the Mississippi valley, we shall include with our own lead district the lead districts of Iowa and Illinois, also the lead and iron mines of Missouri.

On the north, from what little we know along this line, we have a series of undulations or anticlinal lines, along which large deposits of iron are found. Among the most noted is the Penokee Iron Range, in town forty-four. These undulations of the strata, in their bearing and extension, resemble very much the mineral belts of the lead districts, and are collateral evidences, if nothing more, of an underlying north and south line of physical forces of great extent.

7. On the Laws which Govern the Configuration of Comets. By Hon. J. Y. Smith, of Madison.

This paper gave:

1st, A statement of some general *facts* concerning the constitution and form of cometary bodies.

2d, A brief outline of the theory of Prof. Peirce, of Cambridge, concerning the formation of the tails or trains of comets, viz: That a power of repulsion in the comet itself first throws off matter from the general mass as it approaches the sun, and that the sun exerts a repelling power upon the matter thus thrown off, driving it past the nucleus into space and thus forming the train, so far as elongation is concerned—the curve being produced by the particles thrown into a wider orbit falling behind those pursuing a narrower one.

3d. Three objections are brought against this theory, so far as the elongation is concerned: First, that the laws which are supposed to produce the phenomenon of elongation are *assumed*, there being no positive evidence that any such power of repulsion exists, either in a comet in respect to its own matter, or in the sun in respect to the material of a comet. Secondly, if the existence of these forces be admitted, still it is not shown why they should take effect upon one portion only of the cometic matter and not upon the whole of it, nor what is to limit their effect upon those portions upon which their power is exerted; and thirdly, that it ignores the existence and efficiency of well known laws which must inevitably produce the phenomena in question, viz., the laws of gravitation, acceleration and momentum acting upon extremely attenuated matter moving in a highly eccentric orbit.

The theory advanced by Mr. Smith is, in substance, as follows: Cometary matter at repose in space or but slightly acted on by solar attraction, (the latter being the condition of most comets at their aphelia,) possessing fluidity and gravity, however slight the

latter, *must* assume a spherical, or nearly spherical, form. The orbit of a comet being usually highly eccentric, the body moves the greater part of the distance from the aphelion to the perihelion almost in a direct line towards the sun and must, therefore, be subject to the law of acceleration and the varying force of gravitation according to the square of the distance. By this latter law the impulse of solar attraction will be strongest on the side nearest the sun, and less on the opposite side. This, with the slight gravitating power in the comet to hold its particles in a spherical form, must cause the body to hold its particles in a spherical form, must cause the body to elongate to a *spheroidal* form more and more as the difference in the square of the distance between the two extremes of the comet increases and the sqaure of the distance of the whole from the sun diminishes. This elongating process must be assisted, to some extent, by the resisting ether in space (if any such exists) acting upon so light a body.

As the comet approaches the sun from its intersection of the minor axis of the orbit, the angle formed by the radius vector with the tangent of the orbit widens more and more rapidly until they form a right angle at the perihelion. As this angle widens, the centrifugal force comes into action in opposition to the centripetal and a new elongating force is brought to bear upon the cometary mass. Thenceforward these two elongating forces become subject to some curious modifications and transfers of power. That which results from simple solar gravitation, or the accelerating force, goes on increasing as the square of the distance diminishes, and diminishing as the angle of the radius vector with the tangent of the orbit widens, till it reaches the perihelion where this force is reduced to *zero*. At the same time that which results from the centripetal and centrifugal forces goes on increasing both as the square of the distance diminishes and as the aforesaid angle widens, until, at the perihelion, this elongating force reaches its *maximum* power.

The curve of the train is the necessary result of different parts of the body being compelled by the elongating forces to pursue orbits of different breadths with no increase of orbital motion in the outer portions which must needs fall behind the inner and form a curve. When the train becomes largely curved, the centripetal and centrifugal forces are brought to bear *transversely* upon the train and it is spread and flattened, least at the front and more and more at the rear. The elongation, the curving, the spreading and the flattening by the action of these forces, must, necessarily, all take place *in the plane of the orbit.*

When past the perihelion, the laws which brought the comet to its configuration at that point being reversed in their action, their effects are reversed, of course, and the body moves off, straightening, rounding and gathering up its train till it arrives at its aphelion in the same form with which it left it.

Ajourned to 7½ o'clock P. M.

Fourth Session.

The Academy met at the hour appointed; the President in the chair.

The following persons were elected members of the Academy:

CORRESPONDING MEMBERS.—Wm Stimpson. M. D., Secretary of the Chicago Academy of Sciences; J. C. Freer, M. D., President of Rush College, Chicago; Prof. T. W. Safford, Director of Dearborn Observatory, Chicago; Prof. Alex. Winchell, University of Michigan; Prof. James Watson, Director of Observatory at University of Michigan.

ANNUAL MEMBERS.—J. W. Roby, Esq., Milwaukee; E. A. Charlton, President Platteville State Normal School; Prof. Geo. Beck, State Normal School, Platteville.

Reading of papers resumed.

8. On the Kinetic Measures of Force. By Prof. John E. Davies, Wisconsin State University.

9. On the Duty of the State to its Idiotic Children. By Prof. O. R. Smith, Milwaukee.

This paper adduced evidence in favor of the capacity of the idiotic for receiving instruction, and strongly urged upon the State the importance of making provision for this unfortunate class of persons, of whon statistics show the number to be much larger in every community than is generally supposed

10. On the Place which the Study of the Indian Languages should hold in Ethnology. By Prof. John B. Feuling, of Wisconsin State University.

[Published in the Transactions p. 178.]

Adjourned to 9 A. M. of next day.

Fifth Session—Business Meeting.

The Academy met pursuant to adjournment; the President in the Chair.

On motion it was resolved to organize a section of Social Science; which, on subsequent motion, was expanded into a full DEPARTMENT OF THE SOCIAL AND POLITICAL SCIENCES, with the following officers:

Vice President—Rt. Rev. W. E. Armitage, Milwaukee.
Secretary—Rev. Charles Caverno, Lake Mills.
Counselors—President G. M. Steele, D. D., Lawrence University; Rev. A. O. Wright, New Lisbon; Dr. A. S. McDill, State Hospital for the Insane.

On motion there was organized the DEPARTMENT OF THE ARTS, to the several constitutional offices in which the following persons were duly elected:

Vice President—Ex-Governor Nelson Dewey, Cassville.
Secretary—Col. S. V. Shipman, Madison.
Counselors—J. H. Van Dyke, Esq., Milwaukee; Mr. Alexander Provis, Lancaster; Hon. J. I. Case, Racine.

On motion there was also organized the DEPARTMENT OF LETTERS, with the following officers:

Vice President—Rev. Dr. A. L. Chapin, Beloit College.
Secretary—Prof. John B. Feuling, Wisconsin State University.
Counselors—Prof. Wm. F. Allen, State University; Dr. I. L. Hauser, Milwaukee; Hon. Lyman C. Draper, State Historical Society.

The Academy adjourned *sine die.*

SIXTH MEETING OF THE ACADEMY.

The Academy met in their rooms, at 8 o'clock P. M. of July 18, 1871, the President, Dr. J. W. Hoyt, in the chair.

Adjourned to 9 o'clock A. M. of next day.

The Academy met pursuant to adjournment; the President in the chair.

Letters were read from the following persons accepting membership:

Prof. Ezra S. Carr, Oakland, California; J. Wingate Thornton, Boston, Mass.; Prof. T. H. Safford, Chicago, Ill.; Prof. James C. Watson, Ann Arbor, Mich.: Prof. Alex. Winchell, Ann Arbor, Mich.

Mr. J. Murrish presented numerous specimens of the rocks, minerals and fossils of the lead region of Wisconsin.

The President reported that his efforts, in regard to the scientific exploration of the northern part of the state, the present season, in connection with the railroad companies, had not been successful.

The Treasurer reported

The amount of cash on hand at the date of his last report	$783 30
Received for dues, &c	40 00
Total	$823 30
Disbursed since last report	112 00
Balance on hand	$711 30

Of this balance, $600 received from Life Members constitutes a permanent fund, the proceeds of which are only applicable to the general purposes of the Academy.

The proposition heretofore offered to amend section two of the by-laws, relating to the meeting to be held at the time of the exhibition of the State Agricultural Society, was considered and indefinitely postponed.

The proposition, submitted at the last meeting, to amend section eight of the Constitution, so as to provide that the President and Secretary of the State Agricultural Society shall be *ex-officio* members of the Council for the Department of the Arts was considered and adopted.

On motion, it was

Resolved, That the resolution requiring the investment of a permanent endowment fund be so modified as to authorize the investment of the same in any securities satisfactory to the Committee on Finance.

The rules being unanimously suspended for the purpose, the following named persons were duly elected members of the Academy.

LIFE MEMBERS —John L. Mitchell, Esq., Milwaukee, Wis.

ANNUAL MEMBERS.—Prof. W. F. Yocum, Appleton, Wis.; G. F. Luders, Sauk City, Wis.; Rev. W. S. Alexander, Racine, Wis.; Wm. H. Sherman, Esq., Milwaukee, Wis.; H. K. Smith, Esq., Milwaukee, Wis.

CORRESPONDING MEMBERS.—Hon. J. Hammond Trumbull, LL. D., Hartford, Conn.; Prof. S. S. Haldemann, State University of Pennsylvania, Philadelphia; F. Ebener, Ph. D., Baltimore, Md.; Prof. W. D. Whitney, New Haven, Conn.; Dr. J. G. Brinton, Philadelphia, Pa.

It was resolved to publish another number of the Bulletin, to include the proceedings of the last and present meetings.

Rev. C. Caverno announced that being about to leave the state, it would be necessary to resign the office of Secretary of the Social Science Department of the Academy.

The papers read at this meeting were as follows:

1. On the Clay Deposits and Fossils found therein, in the Region about Appleton. By R. Z. Mason, LL. D., Appleton.

The geological characteristics of this region are, 1st. A thin stratum of the lower magnesian limestone overlaying the Potsdam sandstone, all dipping at small angle to the southeast. The limestone in the vicinity of Appleton grows thinner as we go westward, and nearly disappears at the Wolf river, being replaced as a surface rock by the Potsdam sandstone, between the Wolf and Wisconsin rivers. The Lower River flows over the surface of the limestone at a level of about sixty feet below the general surface of the clay deposits. These deposits, of clay mainly, are therefore about sixty to eighty feet deep, and give every appearance of having been made in quiet and shallow seas. Intermixed with these deposits of clay, are boulders, varying in size from a mere pebble to those of many tons weight. These boulders, are granite, quartz, feldspar, hornblende, and trap—the first and last most abundant.

Throughout this entire region there have also been found, at the depth of twenty, forty and sixty feet, large fragments of timber, generally cedar, tamarack and other conifers.

These seem to be the fragments of trees that have grown in this region at an early period, when the temperature was lower than at present, and where the surface of the ground was level and marshy.

The above inference is based on the fact that the forest trees of warmer latitudes and higher regions, such as now grow there, to wit, the oak, the maple, the beech, etc., have never been found in these clays. Nearly all the discoveries of this nature have been made in the digging of wells.

2. On the Ancient Lakes of Wisconsin. By J. G. Knapp, Esq., Madison.

[Published in the Transactions, p. 151.]

3. Suggestions as to a Basis for the Gradation of the Vertebrata. By Prof. T. C. Chamberlin, of the State Normal School, Whitewater.

[Published in the Transactions, p. 138.]

5. Facts relating to the Local Geology of the Whitewater Region. By Prof. T. C. Chamberlin, State Normal School, Whitewater.

This paper consisted of remarks upon the Galena formation, to which the bed-rock at Whitewater belongs, upon the chemical and physical characteristics of the rock, and upon the paleontology of the region, including remarks upon the following fossil genera: Receptaculites chaetetes, Lingula, Rhynchonella, Orthis, Strophomena Murchisonia, Pleurotomaria, Orthoceras, and upon the questionable evidences of plants. The drift phenomena of the region were made the subject of special description and explanation. The peculiarities of its composition and the variety of formation, including beds of clay, of sand, of assorted gravel, of rounded boulders, of rounded and angular boulders, mingled and unclassified forms, the striking features of the surface arrangement and the glacial striæ were particularly noticed.

6. On the Rocks and Mines of the Upper Wisconsin River. By J. G. Knapp.

7. On the seventeen-year Cicada, its Geographical Distribution and Time of Appearance in this State. By Prof. T. C. Chamberlin.

The Academy adjourned *sine die.*

SIXTH MEETING OF THE ACADEMY.

The sixth meeting of tne Academy was held at the City Hall, Milwaukee, on the 26th of September, 1871. Owing to the presence of the State Fair in Milwaukee at the same date, and the engagements of many members in connection therewith, the attendance upon the first session was small. President Hoyt in the chair.

The General Secretary being absent in Florida, on motion, Dr. M. Barrett was chosen Secretary *pro tem.*

Bishop W. E. Armitage moved that the Academy adjourn, subject to the call of the General Council; which motion was carried.

SECOND ANNUAL MEETING.

The Second Annual Meeting of the Academy was convened at the State Agricultural Rooms on the 13th of February, 1872, at 5 o'clock P. M., a large number of members being present.

President Hoyt, on assuming the Chair, made some statements concerning the work of the Academy during the year, and said that,

Inasmuch as many members of the Legislature and other citizens would be pleased to attend a general session, he had asked, and, by courtesy of the Assembly, had procured the use of their hall for the first evening session.

Adjourned to meet in the Assembly Chamber at 7½ o'clock P. M.

N.

The Academy met pursuant to adjournment. Attendance of members and citizens large. The President, Dr. J. W. Hoyt, having called the meeting to order, stated the object of the Academy, in general terms, and announced the titles of the papers to be read at this session, as follows:

1. On the German Sunday. By Rt. Rev. Bishop W. E. Armitage, Vice President for the Department of the Social and Political Sciences.

[Published in full in Transactions, p. 62.]

2. On the Common Jail System of this Country. By Hon. S. D. Hastings, Secretary of the State Board of Charities and Reform.

[Published, in abstract, in Transactions, p. 90.]

3. On the Physical Basis of the Mineral Resources of Wisconsin. By Hon. John Murrish, State Commissioner for the Survey of the Lead Region.

This paper was an elaboration, for the somewhat popular occasion on which it was read, of the paper entitled "Results of Recent Investigations in the Lead Region," read by the same author at a previous meeting, and printed in abstract on a preceding page.

Adjourned to meet in the State Agricultural Rooms, at 9 o'clock of the next day.

Second Session.

The Academy met pursuant to adjournment; President Hoyt in the chair.

The papers read the previous evening were briefly discussed.

Vice President Chapin moved that a committee of three be appointed to wait upon the Governor and solicit accommodations for the Academy's collections. President appointed Dr. Chapin, Wm. Dudley and John Murrish. On motion, President Hoyt was added to the committee.

The following papers were read and discussed.

4. On Aphides observed in Wisconsin. By Dr. P. R. Hoy, Vice President of the Department of Natural Sciences.

[Published in Transactions, p. 110.]

After the discussion of this paper the President called Dr. Hoy to the chair.

5. On the Post Glacial Deposits of Dane county. By Hon. J. G. Knapp, of Madison.

6. Are the great Plains to be always Treeless? By Hon. J. G. Knapp.

Adjourned till 2 o'clock P. M.

Third Session.

The Academy met pursuant to adjournment; Vice President P. R. Hoy in the chair.

The following papers were read and discussed:

7. On the age of the Quartzites, Schists and Conglomerates of Sauk county. By Prof. Roland Irving, M. E., State University.

[Published in full in Transactions, p. 129.]

8. On a Modification of Grove's Battery for a Special Purpose. By Prof. John E. Davies, M. D., State University.

9. On Potential Functions and their Application in Physics. By Prof. John E. Davies, M. D., State University.

[Published in full in Transactions, p. 111.]

Dr. Hoyt resigned the Chair to Vice President Dr. A. L. Chapin.

10. On the Theory of Evolution, illustrated by the Science of Language. By Prof. J. B. Feuling, Ph.D., Secretary of the Department of Letters, State University.

11. On the Rural Population of England as classified in Domesday Book. By Prof. Wm. F. Allen, A. M., State University.

[Published in Transactions, p. 167.]

Adjourned to meet at 7½ P. M.

Fourth Session.

Academy met pursuant to adjournment; Rt. Rev. W. E. Armitage, Vice President for the Department of the Social and Political Sciences, in the Chair.

The following papers were read:

11. Social Science and Woman Suffrage. By Rev. Charles Caverno, A. M., Secretary of the Department of the Social and Political Sciences, Amboy, Illinois.

[Published in full in Transactions, p. 72.]

12. The Relations of Labor and Capital. By Rev. A. L. Chapin, D. D., President of Beloit College, Vice President of the Academy for the Department of Letters.

(Published in full in Transactions, p. 45.]

13. Outline of a Plan for a National University. By Dr. J. W. Hoyt, President of the Academy.

14. On the Coal Deposits of Colorado. By Dr. J. W. Hoyt.

[Reading omitted by author owing to lateness of the hour. For substance of Paper 13, see bill No. 1128 S., now pending in Congress.]

The Academy then went into session for the transaction of special business.

The committee appointed to confer with the Governor concerning provision for the Academy's Collections, reported that his Excellency was desirous of doing everything in his power to aid the Academy, and that he would order new cases so soon as the plans were furnished him.

A majority of the committee appointed to consider the propriety of soliciting aid from the State for canvassing the field and other work designed to be undertaken by the Academy,

reported in favor of asking such aid. Prof. R. Irving, of the said committee, made a minority report, urging the inexpediency of making such a request at this time. The minority report was adopted.

A vote of thanks was passed in favor of Messrs. Landruff and Co., and to Mr. Hollyking, of Highland, Iowa Co., for specimens furnished the Academy's Museum.

A committee consisting of President Hoyt, Dr. I. A. Lapham, Prof. John E. Davies, Dr. A. L. Chapin and Bishop Armitage, was appointed to report any changes in the by-laws deemed desirable, and to take action in regard to the publication of the Transactions of the Academy.

The following persons, approved by the Committee on Nominations, were elected members of the Academy.

LIFE MEMBER:—Hon. S. A. White, Whitewater.

ANNUAL MEMBERS:—Prof. S. H. Carpenter. LL. D., University of Wisconsin; Prof. J. B. Parkinson, A. M., University of Wisconsin; Hon. H. D. Barron, Osceola; Daniel S. Durrie, State Historical Society; G. W. Rayner, Editor Madison Democrat.

CORRESPONDING MEMBERS:—Dr. H. P. Gatchell, M. D,, Kenosha; Prof. Schele DeVere, Ph. D., University of Virgenia; Prof. D. C. Gilman, A. M., Yale College ; Prof. N. S. Shaler. A. M., Ph. D., Harvard University; Dr. J. L. Newberry, LL. D., Columbia College; Prof. E. B. Andrews, Ohio Geological Survey ; Prof. E. Orton, A. M., Antioch College; Prof. T. M. Blossom, A. M., M. E., Columbia College; Prof. A. E. Verrill, A. M., Yale College; Prof. L. D. McCabe, D. D., Ohio Wesleyan University; Dr. G. Wood, LL. D., President University of West Pensylvania; Dr. J. W. Foster, LL. D., Chicago University; Dr. N. Bridge. M, D., Chicago; Wm. LeBarron, M. D., State Entomologist of Illinois; Prof. Oliver Marcy, A. M., N. W. University; Prof. J. S. Jewell, M.,D., N. W. University.

Adjourned *sine die.*

TRANSACTIONS

OF THE

WISCONSIN ACADEMY

OF

SCIENCES, ARTS, AND LETTERS.

VOL. II. 1873–4.

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ERRATA.

re 104, 5th line from bottom, for "them" read "those."
105, last line on page, for "glacy" read "glassy."
108, 5th line from top, place colon after "Wisconsin."
108, 8th line from top, and wherever else it occurs, for "copper bearing rocks," read "Copper-Bearing."
108, 9th line from top, for "lower silurian" read "Lower Silurian."
109, 7th line from top, for "rivers," read "rivers,—"
109, last line, for "its" read "their."
111, 5th line from top, for "schists, one" read "schists. One."
111, 4th line from bottom, for "feet, a" read "feet. A."
111, 4th " " erase "its."
112, 17th " " for "Keweenau" read "Keweenaw."
112, 8th " " for "northeasterly" read "northerly."
116, 15th " " for "occupies" read "occupy."
118, 13th " " for "it" read "they."
126, 19th " " for "coglomerate" read "conglomerate."
127, 12th " " for "dift" read "drift."
132, 11th " " for "phenomena" read "phenomenon."
135, 7th " " for "five" read "fine."
141, 7th " top, for "silver. And" read "silver; and."
143, 14th " bottom, and elsewhere, for "tertiary" read "Tertiary."
143, 9th and 10th line from bottom, for "testiary" read "Tertiary."
150, 14th line from top, for "mates" read "mats."
150, last line, after "sand" insert "above."
152, 5th line from below, for "they" read "it."
193–202, wherever it occurs, for "Bouy's" read "Prony's."
198, 15th line from bottom, for "Hetz" read "Metz."
237, 6th line and elsewhere, for "Earl" read "Eorl."

THE SECRETARY OF THE STATE

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Prof. Thure Kumlein, Albion College, Albion.
Prof. O. M. Conover, A. M., Madison.

* Deceased.

CHARTER.

AN ACT TO INCORPORATE THE "WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS."

The people of the State of Wisconsin, represented in Senate and Assembly, do enact as follows:

SECTION 1. Lucius Fairchild, Nelson Dewey, John W. Hoyt, Increase A. Lapham, Alexander Mitchell, Wm. Pitt Lynde, Joseph Hobbins, E. B. Wolcott, Solon Marks, R. Z. Mason, G. M. Steele, T. C. Chamberlin, James H. Eaton, A. L. Chapin, Samuel Fallows, Charles Preusser, Wm. E. Smith, J. C. Foye, Wm. Dudley, P. Engelmann, A. S. McDill, John Murrish, Geo. P. Delaplaine, J. G. Knapp, S. V. Shipman, Edward D. Holton, P. R. Hoy, Thaddeus C. Pound, Charles E. Bross, Lyman C. Draper, John A. Byrne, O. R. Smith, J. M. Bingham, Henry Bœtz, Ll. Breese, Thos. S. Allen, S. S. Barlow, Chas. R. Gill, C. L. Harris, J. C. Squires, George Reed, J. G. Thorp, William Wilson, Samuel D. Hastings, and D. A. Baldwin, at present being members and officers of an association known as "The Wisconsin Academy of Sciences, Arts, and Letters," located at the city of Madison, together with their future associates and successors forever, are hereby created a body corporate by the name and style of the "Wisconsin Academy of Sciences, Arts and Letters," and by that name shall have perpetual succession; shall be capable in law of contracting and being contracted with, of suing and being sued, of pleading and being impleaded in all courts of competent jurisdiction; and may do and perform such acts as are usually performed by like corporate bodies.

SECTION 2. The general objects of the Academy shall be to encourage investigation and disseminate correct views in the various departments of science, literature and the arts. Among the specific objects of the Academy shall be embraced the following:

1. Researches and investigations in the various departments of the material, metaphysical, ethical, ethnological and social sciences.
2. A progressive and thorough scientific survey of the State, with a view of determining its mineral, agricultural and other resources.
3. The advancement of the useful arts, through the applications of science, and by the encouragement of original invention.
4. The encouragement of the fine arts, by means of honors and prizes awarded to artists for original works of superior merit.
5. The formation of scientific, economical and art museums.
6. The encouragement of philological and historical research, the collection and preservation of historic records, and the formation of a general library.
7. The diffusion of knowledge by the publication of original contributions to science, literature and the arts.

SECTION 3. Said Academy may have a common seal and alter the same at pleasure; may ordain and enforce such constitution, regulations and by-laws as may be necessary, and alter the same at pleasure; may receive and hold real and personal property, and may use and dispose of the same at pleasure: *provided*, that it shall not divert any donation or bequest from

the uses and objects proposed by the donor, and that none of the property acquired by it shall, in any manner, be alienated other than in the way of an exchange of duplicate specimens, books, and other effects, with similar institutions and in the manner specified in the next section of this act, without the consent of the legislature.

SECTION 4. It shall be the duty of the said Academy, so far as the same may be done without detriment to its own collections, to furnish, at the discretion of its officers, duplicate typical specimens of objects in natural history to the University of Wisconsin, and to the other schools and colleges of the State.

SECTION 5. It shall be the duty of said Academy to keep a careful record of all its financial and other transactions, and, at the close of each fiscal year, the President thereof shall report the same to the Governor of the State, to be by him laid before the Legislature.

SECTION 6. The constitution and by-laws of said Academy now in force shall govern the corporation hereby created, until regularly altered or repealed; and the present officers of said Academy shall be officers of the corporation hereby created, until their respective terms of office shall regularly expire, or until their places shall be otherwise vacated.

SECTION 7. Any existing society or institution having like objects embraced by said Academy may be constituted a department thereof, or be otherwise connected therewith, on terms mutually satisfactory to the governing bodies of the said Academy and such other society or institution.

SECTION 8. For the proper preservation of such scientific specimens, books and other collections as said Academy may make, the Governor shall prepare such apartment or apartments in the Capitol as may be so occupied without inconvenience to the State.

SECTION 9. This act shall take effect and be in force from and after its passage.

Approved March 16, 1870.

CONSTITUTION.

NAME AND LOCATION.

SECTION 1. This association shall be called "The Wisconsin Academy of Sciences, Arts and Letters," and shall be located at the city of Madison.

GENERAL OBJECTS.

SECTION 2. The general object of the Academy shall be to encourage investigations and disseminate correct views in the various departments of Science, Literature, and the Arts.

DEPARTMENTS.

SECTION 3. The Academy shall comprise separate Departments, not less than three in number, of which those first organized shall be:

1*st*. *The Department of Speculative Philosophy*—
Embracing:
Metaphysics;
Ethics.

2*d*. *The Department of the Social and Political Sciences*—
Embracing:
Jurisprudence;
Political Science;
Education;
Public Health:
Social Economy.

3*d*. *The Department of the Natural Sciences*—
Embracing:
The Mathematical and Physical Sciences;
Natural History.
The Anthropological and Ethnological Sciences.

4*th*. *The Department of the Arts*—
Embracing:
The Practical Arts;
The Fine Arts.

5*th*. *The Department of Letters*—
Embracing:
Language;
Literature;
Criticism;
History.

SECTION 4. Any branch of these Departments may be constituted a Section; and any section or group of sections may be expanded into a full Department, whenever such expansion shall be deemed important.

SECTION 5. Any existing society or institution may be constituted a Department, on terms approved by two-thirds of the voting members present at two successive regular meetings of the Academy.

SPECIAL OBJECTS OF THE DEPARTMENTS.

SECTION 6. The specific objects of the Department of Sciences shall be:

1. General Scientific Research.
2. A progressive and thorough Scientific Survey of the State, under the direction of the Officers of the Academy.
3. The formation of a Scientific Museum.
4. The Diffusion of Knowledge by the publication of Original Contributions to Science.

The objects of the Department of the Arts shall be:

1. The Advancement of the Useful Arts, through the Applications of Science and the Encouragement of Original Invention.
2. The Encouragement of the Fine Arts and the Improvement of the Public Taste, by means of Honors and Prizes awarded to Works of Superior Merit, by Original Contributions to Art, and the Formation of an Art Museum.

The objects of the Department of Letters, shall be:

1. The Encouragement of Philological and Historical Research.
2. The Improvement ot the English Language.
3. The Collection and Preservation of Historic Records.
4. The Formation of a General Library.

MEMBERSHIP.

SECTION 7. The Academy shall embrace four classes of governing members who shall be admitted by vote of the Academy, in the manner to be prescribed in the By-Laws:

1st. Annual Members, who shall pay an initiation fee of five dollars, and thereafter an annual fee of two dollars.

2d. Members for Life, who shall pay a fee of one hundred dollars.

3d. Patrons, whose contributions shall not be less than five hundred dollars.

4th. Founders, whose contributions shall not be less than the sum of one thousand dollars.

Provision may also be made for the election of Honorary and Corresponding Members, as may be directed in the By-Laws of the Academy.

MANAGEMENT.

SECTION 8. The management of the Academy shall be entrusted to a General Council; the immediate control of each Department to a Department Council. The General Council shall consist of the officers of the Academy, the officers of the Departments, the Governor and Lieutenant-Governor, the Superintendent of Public Instruction, and the President of the State University, the President and Secretary of the State Agricultural Society, the President and Secretary of the State Historical Society, Counsellors *ex-officiis*, and three Counsellors to be elected for each Department. The Departmental Councils shall consist of the President and Secretary of the Academy, the officers of the Department, and three Counsellors, to be chosen by the Department.

OFFICERS.

SECTION 9. The officers of the Academy shall be: a President, who shall be *ex-officio* President of each of the Departments; one Vice-President for each Department; a General Secretary; a General Treasurer; a Director of the Museum, and a General Librarian.

SECTION 10. The officers of each Department shall be a Vice-President, who shall be *ex-officio* a Vice-President of the Academy; a Secretary, and such other officers as may be created by the General Council.

SECTION 11. The officers of the Academy and the Departments shall hold their respective offices for the term of three years, and until their successors are elected.

SECTION 12. The first election of officers under this Constitution shall be by its members at the first meeting of the Academy.

SECTION 13. The duties of officers and the mode of their election, after the first election, as likewise the frequency, place and date of all meetings, shall be prescribed in the By-Laws of the Academy, which shall be framed and adopted by the General Council.

SECTION 14. No compensation shall be paid to any person whatever, and no expenses incurred for any person or object whatever, except under the authority of the Council.

AMENDMENT.

SECTION 15. Every proposition to alter or amend this constitution shall be submitted in writing at a regular meeting; and if two-thirds of the members present at the next regular meeting vote in the affirmative, it shall be adopted.

BY-LAWS.

ELECTION OF MEMBERS.

1. Candidates for membership must be proposed in writing, by a member, to the General Council and referred to a Committee on Nominations; which Committee may nominate to the Academy. A majority vote shall elect. Honorary and corresponding members must be persons who have rendered some marked service to Science, the Arts, or Letters, or to the Academy.

MEETINGS.

2. The regular meetings of the Academy shall be held as follows:

On the 2d Tuesday in February, at the seat of the Academy; and in July, at such place and exact date as shall be fixed by the Council; the first named to be the Annual Meeting. The hour shall be designated by the Secretary in the notice of the meeting. At any regular meeting, ten members shall constitute a quorum for the transaction of business. Special meetings may be called by the President at his discretion, or by request of any five members of the General Council.

DUTIES OF OFFICERS.

3. The President, Vice President, Secretaries, Treasurer, Director of the Museum and Librarian shall perform the duties usually appertaining to their respective offices, or such as shall be required by the Council. The Treasurer shall give such security as shall be satisfactory to the Council, and pay such rate of interest on funds held by him as the Council shall determine. Five members of the General Council shall constitute a quorum.

COMMITTEE .

4. There shall be the following Standing Committees, to consist of three members each, when no other number is specified:

On Nominations.
On Papers presented to the Academy.
On Finance.
On the Museum.
On the Library.
On the Scientific Survey of the State; which Committee shall consist of the Governor, the President of the State University, and the President of this Academy.
On Publication; which Committee shall consist of the President of the Academy, the Vice Presidents, and the General Secretary.

MUSEUM AND LIBRARY.

5. No books shall be taken from the Library, or works or specimens from the Museum, except by authority of the General Council; but it shall be the duty of said Council to provide for the distribution to the State University and to the Colleges and public Schools of the State, such duplicates of typical specimens in Natural History as the Academy may be able to supply without detriment to its collections.

ORDER OF BUSINESS.

6. The order of business at all regular meetings of the Academy or of any Department, shall be as follows:

Reading minutes of previous meeting.
Reception of donations.
Reports of officers and committees.
Deferred business.
New business.
Reading and discussion of papers.

SUSPENSION AND AMENDMENT OF BY-LAWS.

7. The By-Laws may be suspended by an unanimous vote, and in case of the order of business a majority may suspend. They may be amended in the same manner as is provided for in the constitution for its amendment.

REPORT OF THE PRESIDENT.

His Excellency, WILLIAM R. TAYLOR,

Governor of Wisconsin:

SIR—I have the honor to submit the following report of the Wisconsin Academy of Sciences, Arts and Letters for the period commencing September 13, 1872, and ending February 12, 1874:

The work of the Academy, since the date of my last report, has steadily progressed, although the number of active members has not very considerably increased.

The publication of the first volume of Transactions, by order of the legislature, inspired confidence in the permanency of the institution, and has encouraged members to bestow much laborious effort upon their investigations. It also had the effect to gain for the Academy an honorable standing among organizations of like character throughout the country, and has even secured to its objects and early labors the attention and favor of a large number of the learned societies of Europe.

Since the success of every organization of this kind must depend upon the extent to which it is able to enlist the services of the best cultured and most original minds in the community, and since the coöperation of such persons cannot reasonably be asked for unless the fruits of their investigations are sure of being published to the world, it is an occasion for congratulation that the legislature has shown a disposition to

make permanent provision for the annual printing and publication of the Academy's Transactions.*

Of the Several Departments.

The department of Speculative Philosophy was only organized at the late annual meeting, and has, of course, had no development. It is represented, however, by interesting and valuable papers in the collections herewith presented.

The department of the Social and Political Sciences has yielded results of importance, though but few, considering the great breadth of its range and the large number of persons who might with reason be expected to give it the benefit of their services. Embracing Education, Health, Social Economy, Political Economy and Jurisprudence, it presents a variety of distinct fields of great interest and practical importance for the scientific inquiry of nearly every class of intelligent citizens, and should be instrumental of much good by directing public attention to errors of principle and practice in social life and governmental affairs, as well as in contributing something to the progress of social science itself.

The department of the Natural Sciences continues to hold its precedence as the most active and productive section of the academy. Its membership includes a considerable number of professors connected with the State University, Lawrence University, Beloit College, the State Normal Schools, and other institutions of learning, besides many scientific gentlemen not so connected. It is worthy of remark that some of these have not only been willing to give to the academy the time necessary to the solution of important scientific problems, but also to expend considerable sums of money in order to the making of original observations and studies in the open field of nature.

* Since the writing of this report, the legislature has, by unanimous consent, made provision, in the new law relating to public printing, for the future *biennial* publication of the Transactions, in uniform style with the first volume.

The department of Arts has not hitherto met the expectations of those who were active in its organization. The large number of intelligent gentlemen engaged in agriculture, mining and manufactures, as well as the considerable number of engineers, architects and builders, who have had both scientific training and practical experience, and are competent to make valuable contributions to the useful arts, would seem to warrant the expectation that, under the new efforts to be put forth by its officers, this department will have a more satisfactory development.

Effort has been made to induce the artists of this state to unite their forces and effect the organization of a department of Fine Arts, but, so far, without success. Art has had but little cultivation, as yet, anywhere in America. Enough has been done by American artists, however, to demonstrate that we have artistic *genius* of a quality to insure to our art a rank in the future second to that of no other modern nation. An impetus has already been given to it by the introduction of art education into many of the schools at the east, and a few of those at the west—a movement fraught with interest, whether art be considered in relation to its refining influence upon the mind of the rising generation, or with reference to its bearings upon the progress of the industrial arts.

An art department, even though it should, for a time, simply fulfil the offices of an Art Union, bringing artists frequently together for mutual aid and encouragement, leading to the gradual formation of a public art museum, and, by its co-operation with the educational authorities, promote the needed cultivation of art in all its various branches, would render a very important service to the state and to the cause of American civilization.

The Department of Letters, though it has not made rapid growth, is nevertheless in a prosperous condition. It is in the management of gentlemen of deep and varied culture, who have both prepared and secured for it several papers of real

value, and whose zeal in the work is a sure pledge of its success.

The Library.

It is not the policy of the Academy to build up a separate library, but rather to coöperate with the State Historical Society in sustaining and strengthening the Scientific, Art and Literary Departments of its already extensive Library. This it will be able to do in a large degree by securing an exchange of the Academy's Transactions with those of kindred institutions throughout the world, provided its own publications are regularly issued at short intervals—annually, if possible—and have sufficient value to command the respect of learned and scientific bodies having like ends in view. It may be assumed that the Academy will also be able to render some service by indicating, as the result of its members' experience, the most important deficiencies of the Society's Library, especially in the scientific departments, which are as yet but very imperfectly supplied.

The friends of the State Historical Society should therefore regard the Academy as another, and deeply interested organization, resolute in its purpose of promoting the steady and rapid growth of an already extensive and valuable collection of books, in order that it may early become a great State Library, rich in all its departments.

The Scientific Museum.

The scientific collections of the Academy have made a less rapid increase than we were warranted in expecting, under the circumstances. Under the provisions of the statute providing for the survey of the lead region, Mr. John Murrish, Commissioner, collected and sent to the Academy a considerable amount of material, most of which has been placed in the museum, although it has not yet been systematically arranged and labelled.

Chapter 292 of the laws of Wisconsin, "an act to provide for a complete geological survey" of the state, contains the following provision:

"SECTION 3. It shall be the duty of said geological corps, in the progress of the examinations hereby directed, to collect such specimens of rocks, ores, fossils, minerals, etc., as may be necessary to exemplify the geology of the state; sets of these specimens shall be deposited with the Wisconsin Academy of Sciences, Arts and Letters, and the State University, and with each one of the incorporated colleges of the state, and with each of the normal schools, provided application be made to the chief geologist before the commencement of the field work."

Under this provision there has doubtless been collected, during the past year, much valuable material illustrative of the geology and mineralogy of Wisconsin; but, up to this date—doubtless owing to the lack of time on the part of the commissioner to make a proper classification and division of the specimens—little or nothing has been derived from this source.

For such collections as were sent in by Commissioner Murrish and were without shelf-room for their display, his Excellency, Governor Washburn, made suitable provision by the construction of additional cases.

A large museum, illustrative of the several Departments of Natural History, is still and for some time must continue to be a desideratum in Wisconsin. None of those formed by the collegiate institutions of the State are as yet anything like adequate to the wants of their Scientific Departments, much less to the needs of specialists. It is one object of the Academy to meet this want. And when it has so far advanced as to have the means of securing exchanges of specimens with the numerous scientific associations in various parts of the world with which we are seeking to establish relations, it will possess extraordinary facilities for the formation of such collections as will greatly subserve the uses of Science and of Scientific Education in the State.

But, in order to do this, one requisite is still wanting—namely, the means of properly rewarding the labor of preparing specimens and conducting the business of exchange. Add this to the labor of keeping the records of meetings, conducting the correspondence, home and foreign, and attending to the preparation, printing and distribution of the Transactions —all of which has hitherto been performed gratuitously by the President and General Secretary—and it must be apparent that the Academy cannot fairly begin the fulfilment of its mission without pecuniary resources sufficient to salary a Secretary, who shall give his entire time and efforts to its work. And when thus provided, there will immediately arise necessities for yet further means to meet the incidental expenses of office and Museum.

I therefore desire to emphasize these pressing needs of the academy, in order that the purposes for which its scientific department was organized may be kept distinctly before its friends, and that measures may the sooner be put in operation for realizing the funds so clearly requisite to the success of the academy. It is believed that when the objects of the academy come to be better understood, the number is not few of those who will so far appreciate their importance as to regard it a privilege to take Life Members', Patrons', or even Founders' certificates, or to otherwise contribute to its pecuniary resources.

The Treasurer's Report.

The present financial condition of the Academy is shown by the report of the Treasurer for the fiscal year ending February, 1874.

The Results of Work Done

By members of the Academy since the date of the last published report, are chiefly embodied in the following papers:

"Population and Sustenance," by Dr. G. M. Steele, LL.D., President of Lawrence University.

"The Rural Classes in England in the Thirteenth Century," by Prof. W. F. Allen, A. M., State University.

"Vexed Questions in Ethics," by Rev. F. M. Holland, A. M., Baraboo.

"Requisites to a Reform in the Civil Service of the United States," by Dr. J. W. Hoyt, President of the Academy.

"On the Classification of Animals," by Dr. P. R. Hoy, M. D., of Racine.

"On Some Peculiarities of the Fauna of Wisconsin," by Dr. Hoy.

"On the Relation of the Sandstone Conglomerates and the Limestone of the Azoic of Baraboo Valley," by Prof. J. H Eaton, A. M., of Beloit College.

"Results of an Analysis of the Black River Falls Iron Ore," by Prof. R. Irving, M. E., State University.

"On the Geographical Distribution of the Quartzite of Sauk and Columbia Counties," by Prof. T. C. Chamberlin, A. M., State Normal School, Whitewater.

"On the Metamorphic Rocks of Portland, Dodge County, and other Localities in the State," by Prof. R. Irving, M. E., State University.

"On the Occurrence of Gold and Silver in minute quantities in the Quartz of Clark County," by Prof. R. Irving, M. E.

"Railway Gauges," by Prof. W. J. L. Nicodemus, A. M., C. E., State University.

"Fish Culture in Wisconsin—and its Claims upon the State," by Dr. J. W. Hoyt, President.

"On General Correlations," by E. D. Reade, C. E., Milwaukee.

"The Metaphysical Basis of Science," by Prof. S. H. Carpenter, LL. D., State University.

"On Several Points in the Pronunciation of Latin and Greek," by Prof. S. S. Haldeman, LL. D., Cor. Member, Philadelphia.

"Results of the Analysis of certain Ores and Minerals," by Prof. W. W. Daniells, M. S., State University.

"Analysis of the Madison Building Stone," by T. E. Bowman, State University.

"Discussion of evidence bearing upon the Method of Upheaval and Fluctuations of the Quartzite of Sauk and Columbia Counties, by Prof. T. C. Chamberlin, A. M., State Normal School, Whitewater.

"Potentials and their Application to Physical Science," by Dr. John E. Davies, M. D., State University.

"On the Relative Import of Language," by Prof. John B. Feuling, Ph. D., State University.

"On the Place of Natural History in Primary Education," by Dr. P. R. Hoy, Vice President.

"Remarks upon the late Rt. Rev. Bishop Armitage, President of the Department of Social Science," by the President of the Academy.

"On Ranks and Classes among Anglo-Saxons," by Prof. Wm. F. Allen.

"On the Naming of America," by Prof. J. D. Butler.

"On the Origin of the word 'Church'"—by Prof. John B. Feuling.

"On the Strength of Materials," by Capt. J. Nadir, of U. S. Corps of Topographical Engineers.

"On the Age of the Copper Bearing Rocks of Lake Superior," and "On the Westward Continuation of the Lake Superior Synclinal." By Prof. Roland Irving.

"On Records of Marriages," by Rev. F. M. Holland.

"Progress of the Science of Hydraulics," by Prof. W. J. L. Nicodemus, A. M., C. E.

"On some Sample Applications of the Potential Function," also papers on "Molecular Vortices in Electro-Magnetism," and on "Magnetic Rotary Polarization of Light," by Prof. John E. Davies.

"On the Measurement of the Years of Yore," by Dr. Edmund Andrews, M. D., L.L. D., late President of the Chicago Academy of Sciences

"The Philosophy of Evolution," by Dr. S. H. Carpenter.

"On Peculiarities of the Fauna of Wisconsin," by Dr. P. R. Hoy.

"Effects of a Duty on Imports upon the Value of Gold," by Hon. John Y. Smith.

On behalf of the Academy, I have the honor to be,

Very respectfully,

Your Excellency's obedient servant,

JOHN W. HOYT,
President.

MADISON, February, 1874.

DEPARTMENT OF SPECULATIVE PHILOSOPHY.

THE METAPHYSICAL BASIS OF SCIENCE.

BY PROF. S. H. CARPENTER, LL. D.,
University of Wisconsin, Madison.

All knowledge is essentially one. The object-matter upon which intellect exerts itself, does not affect the subjective act of knowing. Physics, when stripped of that which is merely contingent, becomes metaphysics. Physical science deals with object-matter, and discusses the signs by which nature communicates her message—that is, phenomena. Metaphysical science has to do with the subject-mind, and discusses the meaning of the message. The one converts God's hieroglyphics into easily-intelligible language; the other translates this language into Idea. If this be true, there must be a unity of method in all science, however great the diversity of the object-matter investigated. This method is subjectively determined, that is, by the constitution of the mind, and not by the particular form of matter upon which intellectual energy may be exerted. If there is an essential unity in all knowledge, it is because there is a corresponding unity of method in all mental activity. It is only when we look upon what is to be known, that truth separates into sciences; but particular truths become particular sciences only under assumed relations to the whole of which they form a part.

Objectively considered, science is classified knowledge; subjectively viewed, it is the laws or principles according to which knowledge is classified. Every actor implies an act—every

thinker a thought. We may therefore universally make this dual classification, according as we view the mental operation involved, or the attributes of objects which form the subject of thought. The possibility of science is conditioned upon the possibility of classification. Mere knowledge is not science, as the world ought to have learned by costly experience. Even classified knowledge may not be science; it becomes science not through previous classification, but in the act of being classified, and therefore only as the principle of classification is apprehended—that is, only as the particular application of the law of generalization is distinctly recognized. A man may know a book and know nothing more; he knows the science only when he is capable of making the book for himself. Mere knowledge thus differs from science in that the one is held only by the apprehensive powers of the mind, while the other passes beyond these into the reflective or ratiocinative. Pure science, then, must be wholly abstract. The forms and substances of Nature with which the scientific student deals, are only the discrete figures of the young mathematician, to be thrown aside with advancing knowledge. Matter is only the staff on which the mind leans, while too feeble to go alone. It is not the finely chiseled statue that renders a man a sculptor; it is the conception which is therein embodied. A day-laborer may have cut the stone, but only the artist could conceive the idea. So in science, we care but little for the particular results at which we arrive, compared with the laws, according to which the results have been attained.

But conceptions cannot be communicated without being rendered objective. The ideal of the artist is locked up in his own mind, until on canvas, in marble, or by means of some other physical symbol, he communicates his high imaginings. Matter, then, according to the present constitution of things is the condition of intellectual communication. Law cannot be studied as abstract law; it can be studied only while acting, and that which exhibits this activity must be matter—some-

thing which will always and uniformly obey. There can be no conception of force except as acting, and the sole medium of such activity is matter. Thus again, matter is the condition of all communication from nature to man. Science is thus, in a measure, determined by the conditions of its discovery and communication. But we must distinguish between an invariable condition and that which is thus conditioned. Matter is not science; it is only the condition of its discovery and communication. Air is not hearing; it is the condition of hearing. We do not study matter for the sake of the matter when we study science, but for the sake of the law communicated to us in these changes of matter, and Law is a metaphysical, not a physical idea. Reason, not sense, apprehends it. Law is, so to speak, formulated in the physical, but it is not material. Matter is only the vehicle of science, as language is the vehicle of thought.

It is plain, then, that just as in mathematics we have a division into pure and mixed, according as we deal with matter in the abstract or in the concrete, so we may in any science make a corresponding division, according as we confine our attention to the laws revealed by matter or to the matter revealing the laws: in other words; just as we give attention to the ideas of the message, or to the language in which it is communicated. The language must first be learned, but the words used to communicate the message may be separately understood, and yet the meaning of the message wholly missed. Knowing only the one makes a charlatan; knowing the other makes a savan. The sciences based upon this objective study of Nature are denominated Natural Sciences; and because they lisp the first syllables of Nature's message to man, they should be his primary teachers. It is by their aid that the universal message of God to man must be read. They form, as it were, a public highway leading from Nature to God. But the difficulty is that observing men become so absorbed in admiring some splendid piece of Divine engin-

eering that they stop to gaze and wonder, until losing sight of everything above and beyond, they refuse to advance, fondly imagining that they have reached the end of the journey.

The science based upon this subjective study of Nature is called metaphysics. Logic has been defined as "The Science of Thought;" it should be termed "The Science of Thinking." It is not a dead body which we are studying by dissection, but a living, vital Force, which we study by observing its activities. We find here the same error which we find elsewhere — a stopping with the material symbol, and an ignoring of the intellectual force which clothed itself with the symbol. Astronomy is not the science of circles and spheres, ellipses and ellipsoids, but of the Force whose sensible utterances are given in these curves. We might as well call Painting the science of pictures, or Sculpture the science of statues. So Language, the medium of thought, is only a symbol, less material indeed than pictures and statues, but still physical. What we want in "The Science of Thinking" is not the knowledge of symbols, but the knowledge of that which is symbolized. The chemist does not care for the compounds he finds in his retort; he seeks after the truth which these compounds formulate. Metaphysics and Physics evidently agree in this; that both are seeking to frame an articulate utterance of the Idea given in the diverse manifestations of Force — the Idea which includes all Potencies, the summing up of all phenomena into that final generalization which includes the intellectual as well as the material, until at last we reach the essential unity of all Truth.

Science, then, is classification, or the discovery of the principles of classification, rather than an arbitrary acquaintance with things classified. Every science, however, must have an objective expression—that is, must be formulated. In this, both metaphysical and physical science agree; the only difference in this respect is, that in Physics, Nature gives us in the first place the material interpretation of the idea — that is,

the basis of classification—which we have only to translate into idea: while in metaphysics, we first have the idea to which we must furnish the objective utterance. We see here the precise difference between what is called the logical and the natural method—the one being usually called the reverse of the other. The difference is not so much a difference in intellectual procedure as in objective expression. For instance: The botanist has before him the whole range of vegetable forms. He notes resemblances and differences, and groups plants into species and genera, but his work is not ended when these are named and known, and their qualities discovered. He is seeking amidst these multifarious forms for the law of vegetable growth and reproduction. Every organ of the plant is the symbol of an idea, and these ideas form the science of Botany. These Ideas are metaphysical—that is intellectual, and only their sensible manifestation is physical. The symbols of these Ideas, being given in Nature, must be learned from observation before they can be used intelligently, just as words must be learned before one can speak a language. Mastery of the means of expression is as essential to the communication of ideas as is the possession of the ideas themselves. The botanist observes an individual plant, and notes its characteristics. He observes others which possess some of these characteristics whilst others are wanting. He forms a class-type from these agreeing attributes, and gives this new collocation of characteristics a name. Nature never presents this class-type absolutely; it is found nowhere but in intellect. What has the botanist done but to retranslate the communication of Nature into Idea, and then to express this idea by less complicated and less physical symbols? Man's province in this case is simply to interpret the hieroglyphics of Nature into a more readily comprehended language—to express that simply which nature has expressed confusedly. The scientist restricts himself to the interpretation of a single class of symbols, as the Botanist to plants, the Zoologist to animals, but the

end sought in each case is the same—that is, to change all these physical utterances of Nature into Idea, and to secure for this Idea a method of expression involving the least possible materiality of symbol—that is, to change individual facts and phenomena into general principles, which, because abstract, are unchangeable. When this has been done, the work of the Naturalist ceases, but the work of Man, the Thinker is not done; it is only just begun. By assuming the ultimate expressions of the various natural sciences as individual and not as typical, we can treat the truths reached by them precisely as the Botanist treated plants, and, rejecting points of of difference, may find in them all some central idea. This is the province of the metaphysician. He seeks the law of Idea, he determines the law of Thinking, just as all other laws are determined, from a study of the symbols formulating its expression in Nature. When this law has been distinctly enunciated, and freed from all intermixture with the contingent, then the work of the metaphysician ceases, the *summum genus* has been reached. The truths communicated in the symbols of Nature, have been correlated and enunciated, and finally translated from the dialect of man the physical into the language of man the intellectual. Physical science determines the separate words of this message of God, the letters of which are scattered throughout Nature. Metaphysics combines these words into propositions which enunciate a distinct truth. There is therefore neither conflict nor variation between the method of Logic and the method of Nature. The movement of both is in the same direction; the only difference is in the point of starting. And another truth no less important, which follows from the foregoing discussion, is that the method of Nature is fundamental to the method of Logic. Physics should precede metaphysics, but not exclude it; both are essential to every true science, and physics, which stops with physics, leads man by dazzling promises into some Utopian desert only to leave him there to die of hunger. And it is no less true that metaphys-

ics, without this basis in experimental science, is illusory and untrustworthy, wherever the original data are necessarily empirical.

Two conditions are thus necessary to all science: a body of knowable truth capable of being systematized; and an intelligence capable of apprehending and systematizing it. One of these conditions is physical and one is metaphysical; and all true science must be the resultant of Law and Idea, the Objective and the Subjective, the twin forces of Nature and Man. If either of these conditions be wanting, there can be no true science, for science can neither be "evolved from the depths of the personal consciousness," nor can the scattered letters of scientific truth, as given in nature, arrange themselves into the words of a significant message. Knowledge must be classified before it is science, and that which classifies can only be intellect—discovering and enunciating this classification according to the laws of mental action. As prominence is given to one or other of these two conditions we have the division into Logical and Natural, but the fundamental principle of classification is the same in both—it being simply the law of intellectual action—just as the law which governs the action of the levers of a loom will determine the pattern of the woven fabric. There can, therefore, be no conflict between the methods of Logic and those of Nature. The determining element in all classification, whether of the phenomena of Mind or of the grosser phenomena of Matter is uniformly and always the same — the law of intellectual action.

Science then resolves itself into a determination of this Law of mental activity, so that in an ultimate analysis, all science is metaphysical, just as all science primarily is physical. Here, as elsewhere, Law can be studied only in its objective manifestations. The Law of Thinking can be educed only from expressed Thought, but the Law is not objective thought, any more than the idea of the sculptor is marble, or the conception

of the painter is paint. The simplest expression of thought is not the syllogism but the logical proposition. Now, it is plain that if the proposition is the formulation—the material representative of thought—if we study it as we study other natural symbols, we will find in it the fundamental Law of Thinking, and ultimately the fundamental Law of all Science: just as, if it were possible to reduce all elementary substances to one, the chemist would be able to find in that one a condensed expression of chemical science.

What then is a proposition? Simply stated, it is the assertion of relation between two terms; or more abstractly, it is the reference of an individual to its species—the assertion of a classification. We find here the same duality which we noticed above. If we give prominence to the individual notion, we consider the proposition in extension; if we turn our attention to the specific notion we consider the proposition in intention: in the one case referring to the individuals composing the class, in the other to the attributes composing the class-type. The first corresponds to induction, the second to deduction. When we study individuals we study physics; when we study the attributes composing the class-type, we study metaphysics. The Law of Thinking as educed from a study of the proposition is the law of classification. The proposition, considered affirmatively, asserts explicitly agreement between certain attributes of two terms; that is, it asserts a classification. The aim of science is to reach this proposition, to discover and assert the principle of classification—in other words, to formulate metaphysically what nature has presented physically. We must find, then, the first or fundamental law of thinking in this *integration* or classification. This fundamental law may be subdivided into two species, according to the two terms of the proposition; of which the first may be stated thus: "Every possible object of thought is to a certain extent identical with every other"; and as the proposition implicitly states disagreement, the second may be stated thus:

"Every possible object of thought is to a certain extent diverse from every other." The first gives the positive (subjective) condition of the proposition, the second the negative (objective) condition: both together constitute the conditions of thinking. The proposition is thus the assertion of the same in the different. The proposition also asserts, implicitly, the *tertium quid*, or the basis of classification—the class-type, to which both terms are referred—that is, the proposition secondarily asserts an analysis. According to the first condition we have the inductive process; according to the second we have the deductive process. A complete movement of idea from its purely physical symbolization to its metaphysical interpretation, must involve both these processes.

The mind possesses the power of analysis; it can watch its own operations and retrace its steps, until it arrives at the original data of consciousness; but analysis cannot comprise the whole of the logical process. Before there can be analysis there must be something to be analyzed; before steps can be retraced, they must be taken. We must not confound a condition with a Law—the one is a conception antecedent to all action, a genus to which the particular activity may be referred; the other is coincident with action. The one is the medium of the other. We may illustrate this idea by science itself, which is reached only by an analysis of Art. Matter is the condition of the expression of an idea; hence to all but the artist, Art must precede Science, but this cannot be in the case of the artist; in his mind the Idea is first conceived, and there it is given expression in the forms of Art. Here, as uniformly in Nature, the whole absolutely precedes the part—the universal exists before the particular—God before man. Truth absolute thus exists before truth conditioned. Science before Art. Remove conditions and the conditioned becomes the absolute; art and science coincide. But truth which is assumed to be out of all relations, cannot be comprehended by man, and practically is not. Even the universal propositions

of deduction express universality under conditions—that is universality of relation; just as infinity in mathematics means that which passes measurement, while in fact between infinity and measurement there is no relation, and the infinite is thus incomprehensible as an object of thought, although by no means unrecognizable as a necessary condition antecedent to all intellectual action. It is of vital importance that we note this distinction, because reasoning, i. e. classification, is possible only so long as we deal with what is admitted to be under relation: if we assume a term to be out of all relation, it ceases to be an object of thought—it can neither be classified nor unclassified; it is beyond reason. Mathematics can proceed with its investigations only so long as it treats all quantities as measurable; it must wholly cease its calculations if an infinite term be introduced. To claim that analysis represents the complete normal action of the intellect in reasoning, is ultimately to claim that the initial point of thinking is the *summum genus* of thought—God. Now God is undoubtedly the initial point of absolute thought, but he is not the beginning of human thought. Intellectually speaking, God is the final generalization; every movement possible to him must be one of analysis—a differentiation of Himself, so to speak, by negatives. Thus the course of absolute Thought, beginning with God, must be first towards a complete differentiation into ultimate individualization; and lastly a complete integration again of individuals into an infinite whole. This dual action completes the circle of intellectual activity. We have dropped attribute after attribute until we have reached the last possible analysis; but we do not stop here, but by the assumption of attributes we again reach the highest possible synthesis. This must be the method of the divine activity, successive differentiation and integration, the closing in of a mighty circle of infinity, embracing all the finite, but never losing the essential characteristic of the infinite.

Now, if this also represent the exact movement of the finite

mind in action—that is, in reasoning, man must be God. Man is finite. Even his infinite is only the immeasurable—not that which is without the category of measure. He cannot begin where the Infinite begins, at the highest possible generalization,—but he must begin with the finite. If what we have shown above be true, man must begin with the individual, and the first mental act of the positive character of thinking, is the reference of this individual notion to a class. Now the *class-notion* is the same as the individual notion, less certain attributes as *individual* attributes, but gathered into a larger whole. This process is plainly integration; we are rejecting from the new conception whatever prevents enlarging the class. Each higher generalization involves all the attributes of the lower, not individually, but specifically or generically. In the final generalization, extension and intension coalesce. Just as we reach the individual by differentiating a universal through successive negations, we reach the universal again, by integration, by successively denying the negations through which we just now differentiated. The movement of the finite mind in reasoning is thus from the individual through the universal to the individual again.

Science thus parts into two great branches — one seeking to establish principles by what we have called integration, and the other the elucidation of facts by *a priori* reasoning instead of observation. That is, the aim of true science is to free man from the restrictions of the finite, and to place him in possession of the infinite — the closing in of a lesser circle of infinite truth, yet never losing hold upon the finite. In accordance with this view we see science pursuing its integrations until it has identified as composing an essential unity all the various manifestations of force. This is the finite becoming the infinite, for unity is, in so far, infinity — God is one, a unity, not a unit. But we also see science going beyond this point, and by a new series of differentiations reaching truths new to experience, if indeed not impossible to experience.

Between these two limits all knowledge is forever moving. It can never rest. The tide of thought sweeps onward towards the infinite—God following it to its final absorption into the *I Am*, simple being,—while finite man, because of his finiteness, can only reach those universals which are infinite only to human thought. Like men on a journey we leave the train when we have reached our journey's end, but the train passes on out of sight in the distance, sending back, now and then, tokens of its progress, as it thunders over a bridge, or whistles shrill as it nears some further stopping place, until at last all is still, not because the train has stopped, but because we can follow it no further with our senses. Even after science has reached the utmost limit possible to it, it is not satisfied to rest there, but starts at once upon its return trip, to bring to notice undiscovered facts hidden in these mighty generalizations. Thus the pendulum of intellectual activity unceasingly vibrates between the infinite and the finite, never resting, because Idea and Matter, the force of Man and the force of Nature can never be completely identified.

VEXED QUESTIONS IN ETHICS.

BY REV. F. M. HOLLAND, A. M., BARABOO, WISCONSIN.

The best and wisest people differ widely about what is right. John Brown, Stonewall Jackson and Abraham Lincoln, were equally conscientious in their ideas of the duty of Americans towards slavery and the Union. Ardent friends of morality take opposite sides about liquor laws, taxation of church property, Sunday amusements and the use of the bible in the public schools. Similar differences of opinion exist about the duty of dealers to mention defects in their wares, the propriety of giving to strangers who appear needy, and the obligation of speaking the truth when it seems likely to do harm. We need some general rule for solving all such problems, some acknowledged test of right and wrong, some practical moral standard. Two honest men might easily quarrel about the length of a plank, if they had no rule to measure it by; and we quarrel continually about moral dimensions, because we have no established system of measurement.

About a dozen different systems are advocated by moralists, but the fact that there are so many proves that no one has been made sufficiently accurate to take the proper place. This diversity of opinion, about the moral standard, arises from the general disagreement about the essential peculiarity of right, distinguishing it from wrong. Corresponding questions are—what is conscience, and what is the ground of moral obligation?

We may find great assistance in solving these almost identical problems, by turning our attention to another one, which was thought fundamental in ancient ethics, but has received too little attention from modern thinkers, namely, what is our

supreme end, highest good, or rightful ultimate aim? The question once asked by classic philosophy, concerning the Summum Bonum, has been reiterated by Christian theologians in the form of "What is the chief end of man," but modern moralists have not agreed upon an answer. If they had, they could easily have been unanimous about the true moral standard. Given the supreme end, this standard is found in the fact that whatever tends towards the supreme end is right, and everything else wrong in proportion to the degree of obliquity. The true moral test is that of direction towards the highest good. We must locate this pole in ethics before we make a compass. Modern philosophers generally make the compass first, and try to find a pole afterwards, so that we have some dozen compasses pointing all sorts of ways.

One of the oldest and most popular ethical systems, however, owes its commanding influence to its persistent attempt to identify the moral standard with the supreme end. This peculiarity has won the co-operation of such keen philosophers as Epicurus, Pliny, Gassendi, Hume, Locke, Bentham, Mackintosh and Mill, to which great names might be added those of Lucretius, Horace, Lucian, Moliere, Rochefoucauld, Voltaire, Franklin and Lincoln. Rapid progress is being made in this country, as well as in Europe, by this system, which, asserting the supreme end to be Universal Happiness, pronounces all actions right or wrong, according to their tendency to increase or diminish the greatest good of the greatest number. Such at least is the utilitarian formula, which, however, takes an unfair advantage of the fact that the word "good" has two senses, sufficiently distinguished in common use, and means sometimes pleasant or productive of happiness, and sometimes obligatory or obedient to the moral law. The term good may denote either that a dinner is well cooked or that an action is moral. We are practically so well aware of the different significations of goodness as applied to cooking or to conduct, that a system, which founds itself on an attempt to confound together

such radically distinct ideas, is self-condemned. We all know that the least pleasant duties are commonly the most obligatory. The great mystery of life is that true happiness never comes to those who seek nothing higher. The attempt to make happiness the supreme end defeats itself.

Still another objection to utilitarianism has been powerfully stated by Lecky and Herbert Spencer, namely, that there is so great difference of opinion about the real nature and conditions of happiness, that no firm standard of morality can be erected on such an unstable foundation.

Serious as are the defects of the greatest happiness theory, however, no moralist can hope to displace it, unless he succeeds as least as well in recognizing the supreme end in his moral standard. Most anti-utilitarians and semi-utilitarians make no attempt to reconcile these two ideas, but separate them so plainly as to make their systems self-contradictory. This is especially the case with the intuitionalists, or believers in the supreme authority, if not infallibility, of conscience, which theory is further proved to be defective by the existence, not only of such great differences of opinion among its followers about many practical questions, like non-resistance, prohibition and free-love, as to demonstrate its inability to supply a moral standard which can be used with sufficiently uniform results to make it valuable, but also of so irreconcilable a controversy between leading philosophers, about the very fact of our possessing any independent and original intuitions, that to assert them as the foundation of a moral system is too much like building a house on a lot of land, about the title to which there is a law suit. The true system of morality must recognize supreme good higher than happiness, and plain enough to be its own self-evident authority, independent of all metaphysical and theological disputes, so that the moral standard shall be fully demonstrated by its connection with the supreme end. It is also necessary that the true moral standard should not be liable to be disturbed by individual

differences of inclination and interest, and should be applicable to all the relations of life and capable of supplying all needed moral precepts. The true statement of the ethical end and standard must be its own definition and demonstration and need no help from any other theory.

THE PHILOSOPHY OF EVOLUTION.

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The intellectual processes of a rational being must proceed according to some law. They cannot succeed each other at hap-hazard. The notion of rationality is conditioned upon this regular procedure; if this be wanting, the essential character of rational action is wanting. But to say that rational processes are determined by law, and conditioned upon a regular procedure, is simply to assert that the steps in ratiocination are so related to each other that the relation of each to every other may be determined by the application of the law—the difference between any two steps being analogous to the difference between any other two. The astronomer determines the orbit of a planet from three observations, because he thereby determines the law of variation between these points; from which he assumes that this law will be constant, presenting a series of terms each differentiated according the series of differences already determined.

Applying the same principle to mental phenomena, we may determine the law of intellectual action. Thoughts are discriminated by the presence or absence of certain attributes. At one extreme we find the *summum genus*, comprising the fewest possible attributes distinguishing an idea; at the other extreme we find the individual, comprising any number of attributes. Between these two extremes we find a regular series of intermediate terms. The movement of an idea from the general to the individual is like the motion of a planet through one-half of its orbit; while the return movement from the individual to the general, corresponds to the motion of the planet over the remaining half of its orbit The same law governs both movements and unites the two halves of the orbit into a

single whole; and a series of observations taken at equal distances, will, by the uniformity of differences presented, reveal the operation of the same law in this dual manifestation. Upon examining the processes of deduction and induction, we find in each the same series of terms, differing only in the fact that they are in inverse order, and this correspondence reveals the operation of one and the same law. An inductive series is only a deductive series read backward. Any two terms in a series whether inductive or deductive, differ only in the degree of generality, and differ similarly from a third term, so that two being known the third can be therefrom determined. In a deductive series the terms differ by a constant increase in the number of individualizing attributes—a concept being expanded into a deductive series by such regular additions. Having two terms we can proceed to the third—that is, from two propositions expressing this relation, we can proceed to a conclusion. In an inductive series the terms differ by a constant diminution in the number of individualizing attributes—an individual term being expanded into an inductive series, by successively dropping the attributes which compose the individual term, until we reach the required degree of generalization.

Thought must proceed in one of these two directions. The object-matter of thought being composed wholly of attributes can differ only in the presence or absence of certain attributes. A combination, then, of these two movements must complete the intellectual orbit. The direction of the movement of the mind will be determined by the end proposed. When we possess the knowledge of phenomena and wish to discover law—that is, when we seek information—we proceed by induction, from the individual to the general. When possessed of knowledge, we wish to discover its applications, when knowing the law, we wish to determine the phenomena necessarily resulting therefrom, we proceed by deduction—from the general to the individual. Complete knowledge, then, consists in the highest

possible generalization, and the expansion of this term into a series, ending only with the last possible individualization. The aim of physical science is to determine that half of the intellectual orbit which lies between the individual and the general—the aim of metaphysical science is to trace the other half which lies between the general and the individual. When we seek to know what is, we proceed by induction—the method of the phenomenal. When, knowing what is, we proceed to determine what hence must be, we proceed by deduction—the method of the Necessary. Thus Science, at first seeking principles, proceeds by induction to establish them; but after these fundamental principles have been established, it proceeds deductively to determine what must result from them, without waiting to discover these truths by observation.

Knowledge is thus complete just in proportion to the extension of its scope through generalization. The higher the generalization, the more inclusive will it be, and the *summum genus*, or the final generalization, will be the highest attainable reach of knowledge. When man can make no further generalization, his knowledge will be, in so far, absolute and complete, and all that remains possible to him will be the practical application of what he already knows. Perfect knowledge is nothing but perfect generalization. The Supreme Intelligence being hypothetically possessed of all knowledge, that is, having discriminated the absolute *summum genus*, can proceed no further in this direction; his intellectual activity must be exerted in a descending series, or from the general towards the individual, and this process must be, as we have seen above, by a determinate series of steps, fixed by the operation of a definite law, which law proceeds by the successive addition of attributes to the general.

Complete knowledge, being complete generalization, the lines of all science will necessarily converge, as they approach this generalization, until all sciences coalesce in one science, and all truth is reduced to a single expression in the utterance

of the final conception. In accordance with the laws of thinking, this general term is reached by successive omissions of particularizing attributes, until at last we reach Being — the absolute *summum genus*, wholly free from individual attributes, and thereby embracing everything possible to thought, whether material or immaterial. But this *summum genus* must be predicable of this whole. Matter and mind may thus be reduced to a single category, and the physical and the intellectual finally coalesce in this last generalization. Materialism and idealism thus differ merely in the degree of generalization reached — or rather they both agree in avoiding the final generalization which identifies both matter and mind. Materialism must always deal with the individual, for matter can appear under no other form. Idealism must always rest upon the general, for thought, to be thought, must state a generalization. Each, however, finds its explanation in the other, and both are harmonized by the application of the law of intellectual action above given. Matter and Mind are complementary, not incompatible. They differ with each other, but they agree in being similarly related to a third term. Matter is objective; it is thought taking form, becoming individual, manifesting itself in space. Mind is subjective. The one appeals to the senses; the other is known only to the consciousness.

Science reaches its full development only when it includes both physical and intellectual phenomena within its scope. Every step which it takes carries it further from the purely physical, and brings it nearer the purely intellectual — that is the development of physical science is from the individual towards the general, and it reaches its end, its completion, only when the last distinction, that of subjective and objective, has disappeared in the last possible generalization. When the objective has been identified with the subjective, the distinction between Mind and Matter has been obliterated, and we have reached the Supreme Intelligence — the "I Am" of Scripture — simple Being.

Matter is the formal expression of thought, or the necessary condition of such expression, and in this condition is found the link that connects the subjective and objective manifestations of *being*. Subjectivity is ideality, as objectivity is materiality. The consciousness can take cognizance only of what is within itself, and therefore without every other. Consciousness is therefore wholly personal. To communicate an idea it must be placed within the consciousness of another. To reach this result it must cease to be personal, must pass out of the subjective consciousness into objective form, so as to be placed in the same relation to the speaker and the hearer. Thought, out of the consciousness of the thinker, is objective to him, and to render thought objective is to give it material form. Thought to be communicated, must pass out of the consciousness of the thinker into a material representation. The assumption of material form individualizes the idea. The artist's mind may be filled with splendid conceptions, but no one but he can look within his consciousness and see them. Before others can have any knowledge of his thoughts, he must give them form, or embody them in statues or paintings. The soul of the musician may be thrilled by the harmonies that his imagination creates, but no other soul can join him in this ecstasy until he has given form to his conceptions. So the thinker must embody his thoughts in language before he can communicate them to another. Matter, then, is the vehicle by which thought is communicated, and, so far as we are concerned, the necessary condition of such communication, so that the conception of thought apart from the thinker involves the intervention of material forms, and it is by the interpretation of these symbolical forms that we discover the idea.

Now, let us suppose a Supreme Intelligence. The intellectual processes of such a Being, to be conceived as rational by us, must be identical with ours, or at least analogous to ours. The possession of infinite attributes may in fact free him from the control of any law, but it is impossible for us to conceive

an intelligence acting otherwise than in accordance with law. So that if the Supreme Intelligence is to communicate with man, it must be in obedience to the laws which control our mental activities. The Divine thought must, then, like human conceptions, be communicated by means of physical symbols.

The Supreme Intelligence, being the final generalization, must possess all knowledge, and the only intelligent action possible to him from our point of view, is from this absolute generalization towards the concrete and individual. The absolute general is purely subjective, which, to become cognizable, must be rendered objective. This can be secured to us only through the intervention of material forms. From this point of view, matter is only the symbol of thought—thought apart from the thinker. The first result of the divine activity in self-manifestation would be the analysis of *being* into subjective and objective—that is the discrimination of mind and matter, which terms are severally the final generalizations of the two fundamental divisions of science. Matter, then, mere formless, chaotic matter, would be the first result of creative activity. Following the development of this idea in its continually increasing individuality, as new attributes are severally added, matter assumes determinate form and becomes related in systems, as the various so-called elementary substances are discriminated, until finally all truth, capable of being revealed by inorganic matter, is presented to us.

Add the idea of organism and we have the two great divisions of phenomena—material and vital. The higher the generalization, the fewer will be the attributes composing the concept, and thus the simpler will be the form symbolizing its expression. As in the case of matter, the first result of the divine activity was mere matter, undiscriminated by any further attribute; so here, we have, as the first organic creation, a concrete expression of the highest possible generalization comprising the fewest possible attributes—that is, forms of

life involving the fewest individual characteristics. To matter add the simplest organic attribute—that is, the one lying nearest the genus—and we have mere organized matter, the simple cell, the foundation of all life, no matter how great its future complexity, equally the origin of animal and vegetable growth, which are as yet entirely undiscriminated. This would be the first appearance of life.* Differentiating again by the addition of a new attribute, and organic being is subdivided into the two species, vegetable and animal. Beginning with these typical forms, adding single attributes in a continuous series, we at last reach the highest types of animals and plants. Finally, add rationality to the animal, and we reach man, the highest and therefore the most complex type of life, and who, so far as we are concerned, must be the end of creation. We cannot conceive of any higher creation, because we cannot add an attribute to those we already possess, any more than we can conceive of an additional sense by which to cognize such new attribute.

This process has been determined from the very outset by those intellectual laws which we cannot disobey, and which we cannot conceive disobeyed by an intelligent creator. If the law of intellectual action require this process from the simple to the complex, the concrete representation of the steps of this process must indicate the operation of this law, and must also proceed from the simple and rudimentary to the complex and highly developed. An intelligent Creator in revealing his thought must follow the method which our minds must follow in interpreting this revelation. When we know and seek to communicate our knowledge, we proceed from the general to the specific.† The Creator assumed to be infinite in knowledge would therefore follow this process instead of the method peculiar to investigation. The law of intellectual action de-

*This, of course, does not absolutely determine the order of organic creation; as in the case of the syllogism the conclusion or either premise may be the proposition first enunciated, the order of expression being determined by circumstances.

†Compare the demonstrations of Geometry.

termines this method, and the conditions of intellectual communication determine the representation of this method in the material expression of the ideas communicated. Considering the operation of this law under these conditions, we find that the thought communicating only, as nearly as may be, the generic idea, will be distinguished from it by the addition of but a single attribute as the generic by itself is incapable of being represented in concrete form, the expression of this thought in form will present us matter distinguished from matter in general by but a single attribute. The least possible individualizing attribute added to the highest possible generalization gives us the simplest expression of an idea, and the form or the organism symbolizing this thought will be the simplest form and the simplest organism possible. For instance: in organic life the highest generalization barely individualized will give us the simple cell; and no matter what degree of complexity we subsequently reach by the addition of an almost infinite number of attributes, we nevertheless begin in every case with the same starting point.

Each higher type is reached by adding to a lower. The higher thus embraces all that can be found in the lower, and something besides. This method is invariable, and can never be departed from. The genus must always be predicable of every individual component of every species contained under it. Translating this law into the forms of material expression, and it requires each higher species to physically include all lower species, and to differ from them only by addition. Man, the highest type, must thus include all the attributes of the cell as physically expressed, and without them he would not be man. The differences between no two terms in a series can be total. If the successive steps in a train of thought must be related, so that no two notions will be wholly distinct from each other, these notions will constitute a series, each term of which will, in a measure, determine the next, so soon as the law of the series is discovered; and if this train of

thought be objectively presented, it will afford a corresponding series of physical terms, each one of which will in like manner determine the next. But thought is impossible unless by a train of ideas so related. Its physical expression will therefore be equally impossible except by a series of physical terms similarly related, each one of which in some manner determines the next. There must then be a perfect continuity in the line that reaches from the simplest form of matter through all grades of organic life up to man, the highest expression of the divine idea. There can be no break in the chain of thought, because the law of the logical process forbids it: there can be no break in the series of material symbols for the conditions of concrete expression equally forbid it. A symbol is nothing except as it represents that which is to be symbolized. So the symbols form a physical series, because the thoughts symbolized form a logical series.

If the creator has fully revealed his thought, it must be by a series of physical terms arranged in such a manner as to indicate the logical series of ideas symbolized. Every form of matter is a symbol of thought, and challenges interpretation. Every change in form corresponds to an antecedent change in idea, and must be intended to reveal it. As thought, then, begins its evolution with the general and proceeds to the individual by a series of terms each of which is similarly related to both extremes, we must find the material enunciation of this process assuming the form of a series of terms, beginning with mere nebulous matter, grading into organic life, and organic life presenting us with a similar series beginning with the mere cell and ending with man. So rigid and invariable must this serial arrangement be that if a term in either series be wanting, we are authorized to hypothetically interpolate it.

"Nature never makes a leap" says the scientific investigator, as he studies the material symbols of thought. "Thought never makes a leap," says the metaphysician, as he studies the necessary laws of rational action: and both have uttered the

same truth. We prove a proposition by determining the steps by which it was educed from a more generic statement. Science must proceed in the same manner, for science only discovers the track of mind—it does not make the track, it only follows it. If then we find the chain of evolution broken at any point, science must either stop there, or assume the wanting term in the series. We have the right to interpolate these missing terms, for we must assume that the thoughts of God communicated to us in material forms constitute a continuous revelation, beginning with Himself, the final generalization, and ending with man the highest individualization. These limits are fixed—the one by the nature of God, and the other by the nature of man. Between these two extremes we must find a series of intermediate terms. Any other conception of their relation than that of a determinate series is impossible and irrational; and a series, so far as it means anything, means evolution of some sort. Finding the relation between these terms—distinguishing the *same* which reproduces itself, and the *different* which introduces a new term—that is, determining the law of apparent evolution—is the problem presented to science.

The astronomer found Bode's law to all appearance violated by the omission of a planet between Mars and Jupiter. He could see no reason for the law, but if the planets had been placed by an intelligent Creator, some order of arrangement must be discoverable according to which their position was determined. The Creator being intelligent, it is impossible to conceive them placed fortuitously. There must then be a link between Mars and Jupiter, because the law once established cannot be broken. The same law may be observed in the arrangement of leaves around the axis of a plant. If intelligence arranged them they must be arranged in some order, for intelligence never performs the least act without a purpose. Each leaf or pair of leaves is not a mere duplication of the previous leaf or pair of leaves. The relation which subsists

between any two sets in the series expresses the idea of the Creator, and this must be constant. Completing the series as indicated by different plants, we may assume that if any term is apparently wanting, it is only because it has not been discovered. In neither of these cases would it be asserted that any physical evolution had taken place—the terms form a series of which each term is equally determined by the operation of a fixed law; and yet it is an operation precisely analogous to that which in the case of animals presents every appearance of a real evolution. Take, for instance, a series of animals, presenting at one period of time the simplest and most rudimentary forms, and at another the most complex and highly organized; we cannot do otherwise than conceive these two extremes as related by intermediate terms, through the operation of some law which holds good throughout the series. The relation subsisting between any two, must be the same as that subsisting between any other two similarly situated, or a departure from that relation which is itself governed by a definite law discoverable from a comparison of two sets of terms. The application of this law is so universal and so rigid that we need not hesitate to interpolate a missing term, and confidently assert that it either does exist or has existed. To deny this principle is to deny the necessity of continuity in reasoning. This continuity of thought is represented in matter by the persistence of generic forms under specific differences. But just as the specific is the generic with certain additions, so the individual is this same generic with still further additions; and these additions, whether considered solely in space, as given in the symbols of physical science, or in time as in the conceptions of intellectual science, must be determined by the same unvarying law. The persistence of the same form furnishes us the means of identifying this relation, while the differences reveal to us the successive steps by which the generic was differentiated into the individual.

If the creative thought has been expressed by the forms of

matter, the laws of thought must be thus expressed in the relative forms of matter. Anything less than this, while it might interpret isolated ideas, would not communicate the method of the creative process, and science is nothing but the discovery of this method. If the terms of the logical process must be arranged in a series, the physical symbols rendering this logical process cognizable, must be arranged in a similar series, for science becomes impossible when the logical process becomes undiscoverable.

The differences between the terms in this series must be cognizable. Two terms which are indistinguishable are practically identical; and two terms which are not identical vary by a difference which is cognizable by itself apart from either term. The steps in the logical evolution of the final term *Being* must be separable to be cognizable, and the material forms interpreting these steps to the senses must also be distinguishable. A species differs from the genus by the addition of at least one attribute. Now, if the species is distinguishable from the genus, the attribute which differentiates it, must be separately cognizable—so also the individual differs from the species by the addition of attributes, which must in like manner be separately cognizable, or the species will never be conceived independently of the individuals. A thought cannot proceed by insensible steps, nor can its material expression vary otherwise than by determinate and distinguishable differences. The distinction of species is thus a logical necessity. The addition of distinct attributes to the genus gives origin to distinct species; variation in attributes not affecting their substantial identity gives rise to varieties. One species, then, cannot become another, except by the assumption of a new specific attribute, so that one species passes into another precisely as the genus passes into the species, and that is just as, and not otherwise, than one thought passes into another.

The fundamental law of the logical process is that we pass from the generic towards the individual; from the simple to

the complex. Induction can proceed only by assuming a genus at the outset—that is, by assuming certain attributes in the individual to be generic. Translate this law into material forms, and we have each higher—that is more complex—species evolved from the lower by the addition of some new characteristic. This new attribute cannot be added by the functional activity of the lower organism; that can only reproduce itself. A thought does not change merely through repeated expression. We pass to the conclusion of a syllogism, not from each term, but from a comparison of the premises—and this requires an intellectual operation entirely distinct from a mere apprehension of the terms. It is one thing to comprehend the premises; it is quite another to deduce a conclusion from them. It may necessarily follow, but it requires a separate act of the mind to reach it. Premises will not of themselves reach a conclusion.

Reading this same truth in the forms of matter, we may say that species will not pass into higher species without the intervention of a force distinct from either. The impulse which adds a new attribute must be intellectually separable from all those pre-existing, and its material representation must be physically distinct from pre-existing forms. This complete separability precludes the possibility of mere physical genesis. The added attribute is presented by a new form of matter, revealing the presence of a new thought—a new effect, requiring the agency of a new cause. In accordance with the usual economy of nature, who never duplicates her forces, change will be made only so far as may be necessary to communicate the additional idea. Organisms representing previous thoughts will be added to, in order to express the expansion of the thought, instead of a creation *de novo* in each instance. Thus an indentical cellular structure will be found in all organic beings, from the lowest to the highest, each higher type carrying forward the idea and its physical expression found in the lower. The differences between no two terms in the series can

be total, nor can any two terms be identical, as each higher species will embrace all the attributes of the lower, differing only by the addition of others. This is simply the physical expression of the logical truth that whatever can be predicated of the genus can be predicated of every individual contained under it. As the individual is only the expansion of the genus, so higher physical types must also be similar expansions of lower.

Here, then, is evolution, or development: primarily an evolution of the generic into the individual, the continued differtiation of a generic idea through successive individualizations, each adding to the previous group of attributes, thus rendering the idea increasingly complex; and, secondly, an apparent physical evolution or development, interpreting this logical process by a series of physical forms so related as to reveal the relation existing between the thoughts thus interpreted. In the physical representation of the ideas so related, there must be an apparent physical evolution—that is, the process of evolution logically must, like the ideas thus evolved, have a physical expression, and the successive steps in this logical evolution must be revealed by material forms bearing an analogous relation, and thereby expressing the logical process. Matter is nothing, so far as we are now concerned, but the condition necessary to the objective expression of thought. Every phase of matter is simply an objective formulation of a corresponding phase of thought. Every addition to form implies an antecedent increase of thought, as there can be no formal expression until there is something to be expressed. There can, then, be no such thing as mere material evolution, for whatever is material is only symbolical.

Matter being thus wholly inert, the origin of the impulse towards greater complexity must be sought for outside of that which undergoes the change. The movement by which one species becomes a higher is not an elaboration, an extension or a differentiation of existing attributes, but involves the posi-

tive addition of a new attribute, different and distinct from any or all previously existing. One species cannot pass into another by an innate impulse, for a species is an entity composed of a determinate number of attributes, and all attributes potentially present must be considered as actually present. We cannot say that the child is a different species from the man, and that one passes into the other by a process of evolution, because all the essential attributes of the man are potentially present in the child. If the polyp, by the action of innate forces, operating through a series of ages, however extended, can, without any impulse from without, develop itself into a man, then the polyp is as much a man as a boy is, differing only in the time required for development: and the data for the final deduction of the highest types of creation must be furnished in the most elementary forms of life.

The force manifesting itself in organic life is readily distinguishable from the organism by which it is manifested. Life and organization are not synonyms; one is the condition of the other, but a condition is not a cause. We can consider force apart from organism, and this possible separation in thought proves that the same form may not represent both, but that life can absolutely exist apart from organs which serve to give it a physical manifestation.* Physical life being conditioned upon organization, whenever the organism varies, the vital force thus manifested must also vary, such variation being necessarily antecedent to its manifestation. The organism varies, because it must, in order to express the added thought. Change in organism, therefore, is not induced by simple organic action, because the organs and the force acting through them can be distinguished. Assuming that matter is the objective or formal representation of thought, there can be no change in the material expression without a corresponding change in the antecedent conception. There can, then, be physical evolution, only as there is antecedent logical evolu-

*As in the case of man after the death of the body.

tion, and then only because of this logical evolution and not because of the operation of an innate organic force. Force, whatever may be its genesis, is only the exertion of power, not the increase of it. Exertion limits the view to the force immediately in operation. We may replace one manifestation by another, but the quantity is neither increased nor diminished by this change. Change in form implies the operation of force: and apart from such manifestation in matter, it escapes the tests of science, and passes into the purely metaphysical notion of cause. And unless the operation of force be constant, or, if different forces are blended, variable according to some determinate law, the action of which is constant and discoverable, so that the different units of force are separately measurable, the force thus irregular in its action can never be placed in any scientific category. Evolution, then, cannot proceed from any innate organic impulse, unless the force that tends to exact reproduction, and the force that induces a change be equally and separately cognizable. Change must proceed according to some law which accounts for the change, and distinguishes between the normal exertion of power and that exertion which causes a deviation. Science, to be science, must explain apparent exceptions as fully as the regular operation of forces, and that which causes the irregularity must be as distinctly cognizably by itself as the force which acts regularly. Anything less than this is not science. The discovery of Neptune was the result of the application of this principle; it was a successful attempt to discriminate the force which caused variation from the force which operated regularly.

Each species represents the operation of certain vital forces, and one cannot physically pass into another except by the increase of this force, or at least by a change in the manner of its manifestation; and this increase in amount or this change in direction must separately be accounted for. Nor does it matter, for the purposes of this discussion, as to the genesis of this added increment, further than to show that its origin must

be exterior to the organism by which its presence is manifested; for vital energy acting through an organism is a unit, and cannot, even in thought, be separated into distinguishable portions. Change in the direction of vital energy indicates that the original impulse has been modified in its action by encountering another force, for nothing but force can change the direction of force. It does not fall within the range of this paper to determine the nature of this exterior force which is thus distinguishable from that acting through the vital organization, and therefore capable of separate objective representation. Metaphysically we may say that force is resolvable into will, but will being purely personal is incapable of material representation, and thus cannot enter into the determinations of physical science, which does not seek to discover the origin of force, but deals solely with its presence.

As the logician must assume his premises, and, as a logician, cannot question their truth, so the physicist must assume a force in operation, and, as a physicist, cannot examine its genesis. The physical or the metaphysical method of inquiry is valid only so long as restricted to physical or metaphysical processes: a mixture of the two methods will give results satisfactory neither to science nor to philosophy. As logic furnishes no criterion by which to test the absolute truth of propositions, but deals wholly with conclusions drawn from given premises, so science furnishes no data by which to determine the absolute genesis of force, but restricts its enquiries to the phenomena resulting from a force given. For the student of physical science cause and effect is only the transference of a given and determined force from one material form to another. If this idea is to be traced further, it must be studied outside the limits of physics. This study belongs to metaphysics.

Now, if physical science does not deal with the origin of the initial force, but assumes at the outset its presence, no more does it fall within its province to examine into the origin of the increments which give to physical forms that variety which

renders science possible. Science deals with results, not antecedents; and after having determined results, it is not authorized to affirm that one species has produced another by evolution, or has produced it at all. If there are agreements between different organisms by which they are brought into relation, there are also differences by which they are discriminated, and these differences imply increments of force; and to assert that one organism has evolved another is to determine not merely the presence of this new increment, but also to determine its origin. Scientific investigation deals with phenomena which give evidence to the senses of a *transference* of force from one form or from one manifestation to another. Transference is not increase—an effect can be no more than the evolution of what was potentially present in the cause; it cannot add to it. The origin of the force must be investigated according to intellectual laws.

It has been argued that a Supreme Intelligence in manifesting his thought will, according to the necessary laws of rational activity, pass from the universal and general to the particular and individual, or from concepts involving few attributes to those involving these and others; and that these steps in the rational process must be represented in a corresponding physical series; and that the communication of thought is conditioned upon this physical representation. If the logical series comprises one thousand terms, each related to the preceding according to logical law the physical series must comprise one thousand terms, each physically related in such a manner as to reveal this law. As the highest generalization comprises the fewest attributes, the concrete expression of this idea will present the simplest possible physical form and the least complexity of organization, and thus will present the lowest types of life; and as the individual comprises the greatest number of attributes, its concrete expression will present the greatest complexity, and consequently the highest type of life.

We have seen that the logical process begins with the general and ends with the individual; its material expression must therefore begin with the lowest orders and end with the highest. But the individual cannot be immediately derived from the general without the intervention of intermediate generalizations. No more in the concrete expression of this deduction can we pass from the lowest types to the highest without the intervention of an intermediate series. These intermediate terms are not capable of independent interpretation; they find their full explanation only in the extremes of the series—God and Man.

If, then, in the intellectual process from the abstract and universal towards the concrete and individual, we find a constant evolution of idea, each advance being an addition to the previous conception, each new term in the series embracing all the attributes of the preceding, and differing only by addition; and if thought is possible only on this condition; it necessarily follows that the material representation of this thought must present physical forms similarly related, so that, leaving out of view the intellectual genesis of this relation, the observer might conclude that these forms compose a series evolved from a primordial cell in accordance with an organic law. But such we find to be the universal law of intellectual procedure: this apparent development or evolution must, therefore, be the condition of the communication of such intellectual process, and the physical terms are brought into this relation by the fact that they symbolize the logical process. If the material symbols of thought were unrelated physically, the thoughts thus expressed would also be unrelated and independent. But such a supposition renders Science impossible, for its one aim is to find the *same* in the *different*. If there be no *same*, there can be no science: if there be no *different*, there can be no science. Thought proceeds by adding the *different* to the *same* in an endless series, and this addition of the *different* to the *same* expressed in concrete forms is

what is called evolution. If no evolution were apparent in Nature, there could be no Science; for those steps which to the naturalist indicate evolution, being only the physical expression—the formulation — of the logical process, afford the means by which the student reaches the highest generalization. If these steps be wanting, he cannot proceed.

Admitting then to its fullest extent the fact that, judged from a purely physical point of view, all organic forms seem to have been derived each from its immediate predecessor, by a mere functional impulse; and admitting that science is possible upon no other condition, we claim that these material forms are brought into such relation by intellectual evolution, and not by physical genesis; they represent an evolution of Thought and not an evolution of Matter. We know from consciousness that this process of evolution is the method of our thinking. We know also that the divine thought can be rendered intelligible to us upon no other hypothesis than that which supposes it to be governed by the laws which control human thought. Translating the physical symbols which we see about us, and which present this appearance of evolution, we infer that this is the method according to which the Divine Mind proceeded. Science will not materially err in its physical results, if it adopt the hypothesis of physical evolution, but it must confine its attention to physics; it is only as we attempt higher generalizations that the insufficiency of the hypothesis becomes manifest in its failure to satisfy the conditions of the problem as presented to philosophy.

DEPARTMENT OF SOCIAL SCIENCE.

POPULATION AND SUSTENANCE.

BY DR. G. W. STEELE, LL.D.,
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The question of the increase of population and its relation to sustenance is one of the most interesting with which social science has to do. The subject, it is true, does not affect us so directly and imperatively here in the United States as it does the more crowded communities of the old world. We have as yet thousands of unoccupied acres, where for centuries to come additional millions may gather subsistence; while in Europe there are millions who are in continual danger of pauperism if not of starvation. There are supposed to be too many people for the territory they occupy, and the question is how to cure the evil or rectify their social irregularity. This question becomes a serious one in view of the doctrine largely prevalent in certain circles that by a natural law population increases by a ratio ever becoming greater than that of the increase of sustenance.

The remedies proposed for this state of things are mainly two, viz., emigration, and the restraint implied in abstinence from marriage. So far as the former is concerned it is a fortunate fact that there are countries to which the surplus of over-populated communities can emigrate. Yet this resource is unavailable to multitudes of those who need it most; and at best, it is only a temporary relief. Sooner or later the

habitable portions of the earth must be filled to their utmost capacity, so that not another human being could find subsistence, if nature takes its own course without artificial obstruction.

The second remedy, which is yet a precaution rather than a remedy, has two forms. The one is that of restriction by public law; the other, that of self restraint. The former has been tried in several countries, but with different success. The fact that it has been abandoned in some of them which are now still more populous, though less over-populous, than before the remedy was applied and abandoned, would seem to militate against it. A project so unnatural and fanatical is not likely to be largely accepted among men of practical wisdom. Nor is the other form of the remedy more promising. The influence to be exercised by self-restraint in relation to a course of action to which both nature and inclination powerfully prompt, must depend upon such a degree of moral and spiritual development as seldom exists among the classes which are chiefly to be benefited. Even so it must be in the line of motives which nature itself furnishes and not in antagonism therewith.

If, then, the law of the increase of population referred to really exists, it would seem that no humane or prudential provision to prevent or remedy the evil is practicable. These only remain frightful "checks of war, famine and pestilence," which by destroying a portion of the human surplusage, will temporarily relieve the remainder.

This prospect is indeed still more appalling in view of another law announced by an eminent economist. Says Mr. Mill:

"After a certain and not very advanced stage in the progress of agriculture; as soon, in fact, as mankind have applied themselves to cultivation with any energy, and have brought to it any tolerable tools; from that time it is the law of production from the land, that in any given state of agricultural skill and knowledge, by increasing the labor the produce is not increased in an equal degree; doubling the labor does not double the produce; or, to express the same thing in other words, every

increase of produce is obtained by a more than proportional increase in the application of labor."* "This general law of agricultural industry," says Mr. Mill, "is the most important proposition in political economy."

Now if there be a law in accordance with which the human race must go on multiplying till there shall not even be standing room for them upon the earth, unless checked by famine, pestilence or war, or by such restraints as are both unnatural and impracticable; and if there be another law by which the same amount of labor gives less and less means of sustenance, the prospect for humanity is indeed deplorable. These two laws combine to form the doctrine "that there is in the constitution of earthly things a positive, natural and ever-increasing disparity between the production of human life and the capability of the earth to support it." They agree with each other in this respect, if in no other, that they are as discordant as possible with all the other managements of Providence of which we know anything. Such an hypothesis needs to be carefully examined before it takes its place as an admitted principle of social science.

It becomes us to be suspicious of any proposition which is out of harmony with the general order of nature. The doctrine under consideration is certainly adapted to excite such a suspicion.

It is, no doubt, to be admitted that during considerable periods of history, and in many portions of the earth, the increase of population has been very rapid. It may also be admitted that in many of these times and places the mortality has been frightfully large. In some of these instances the population has increased faster than the means of sustenance. But it does not necessarily follow that the vast number of births was the cause of the extraordinary number of deaths, or that the diminished proportion of sustenance was owing to the too great number of births. It is clearly possible that the increased number of births was an effort of nature to supply the

*Political Economy, Bk. I, Chap. xii, § 2.

demand made by the fearful mortality; for this is what nature is perpetually doing elsewhere; depletion at any point being the occasion of a grand rally of forces to supply whatever loss has been sustained, and so restore the equilibrium. It is also quite possible that the lack of sustenance, instead of being a natural co-operating cause of the mortality, may itself be the effect of the same unnatural cause to which the other derangements are due; the predominance of the animal over the spiritual elements in man. For in some of the same countries in subsequent times has sustenance been produced for a much larger population where the mortality has been less; and in no country have the capabilities of the soil for production ever yet been exhausted.

These possibilities become more obvious and tend more strongly in the direction of probabilities in view of certain analogies which themselves hint, at least, at a natural law capable of universal application. It is well known that the insects whose term of life is but a few days are produced by myriads; animals whose term is half a dozen years, are reduced as to the number of their offspring from thousands to only hundreds; while those which live a score or mere of years, are proportionately less prolific. The principle here unquestionably is that the power of reproducing life is in the inverse ratio to the power of maintaining it. May we not suppose this law to extend not merely to all the various *species*, but also to the varied conditions of the *several* species, including that of man? The facts of history would seem to warrant an affirmative answer.

That there is no such thing as a natural law of uniform increase of population can be made tolerably evident to any ordinary observer. Providence works here as everywhere else, according to the conditions and requirements of the case. Hitherto, while there has sometimes been a rapid increase, at other times this increase has been slow or has entirely ceased. In many instances where, according to the natural order of

things, there would have been a steady growth of numbers, owing to the operation of unnatural causes, whole continents have been rendered less populous at the close of a century than at its beginning. The number of births may have been two-fold greater in one generation than in the preceding, yet because of devastating wars, or cruel oppressions of the lower classes, or an unjust and unnatural economical system by which the fruits of industry were unequally distributed, resulting in famines, pestilences, and other various sufferings among the masses, there has been a diminution of the population rather than an augmentation.

Again, nature, as already stated, works here, as everywhere else, not stiffly and inflexibly, but according to the demand made upon her. Just as when a bone is broken, or there is a lesion of muscle or membrane, she concentrates extra forces at the point where repairs are needed, producing in unusual quantities what is requisite to supply the need; so after destructive wars or other seasons of extraordinary mortality, the births are more numerous than before. It is so, also, where from any cause there has been a disproportionate diminution of either sex; nature hastens to restore the equilbrium. We might doubtless gather from these few simple observations, the general principle that nature, in relation to the increase of the race, would vary according to the means of support she herself would furnish; and that if any portion of the population lacked sustenance, it would be not because the increase of population was greater than that of sustenance, nor because of the lack of artificial and unnatural restraints, but because of unnatural and unequal distribution of the natural means of sustenance.

The rate of the increase of population in the different communities of the world is so variable as at first to seem to defy any attempt to infer a general law, and certainly such as to render obvious the impossibility of a law of uniform increase. It is a well known fact that the Aborigines of this continent

have always been noted for the slowness of their increase, and that, too, while occupying a soil and climate capable of affording sustenance many hundred fold greater than their demands. The tribes of the Pacific and South Sea islands are conspicuously prolific. In Great Britain and Ireland the population doubless in about sixty-five years. In Great Britain alone it doubles in about fifty years. In France not very dissimilarly situated on the whole, at the present rate of increase, it would require two hundred and seventy-seven years to double the population. In the United States, deducting the increase from immigration, the population doubles in about thirty years. The variation would be found doubtless quite as great if we should compare other countries.

But while we can deduce no law of increase, nature is by no means lawless or capricious either here or elsewhere. There is unquestionably a grand general principle governing this whole matter and beautiful in its adaptations; a law which is self-adjusting and to which men may readily adapt themselves without arbitrary artificial restraints. It is that *the increase of populatton is inversely as the advance of civilization;* or that the fecundity diminishes as the mental and moral development increases. There are some apparent exceptions, as among the hunter and, to a less extent, the pastoral tribes; but, as a whole, we shall find that it holds good. It is doubtless involved in the great law before alluded to, which evinces itself in the fact that the lower the order of animal life, the more prolific.

Manifestations of this law are obvious in the fact that the greatest fecundity in our times is found among the drudges of civilization — the former slaves of our Southern States and the lower classes of tailors in Europe and among the immigrants to America. Here the animal prevails over the rational nearly to its utmost; matter almost entirely subordinates mind. There is little of self-respect and little of hope. To talk of self-restraint to persons so conditioned, yet where such a remedy

is needed if anywhere, would be preposterous. It would be urging a duty for which they have almost no motive. The question of over-population and its alarming consequences, can only arise in a community where by vicious and unequal laws, the class of mere laborers, uneducated and unsagacious, is kept unduly large, where there is a constant effort by capitalists to keep labor cheap, and where, as in England,* small properties are discouraged, and agriculture, mechanical pursuits and direct commerce are made subordinate to the trade which keeps the producer and consumer at the greatest practicable distance.

It is thus, nearly everywhere in modern civilized society, that where man is at the lowest grade of mental development, where the animal subordinates the rational, there fecundity is greatest. The cause is not gross sensuality; for that is antagonistic to increase of population; but one involved in the very constitution of things and proceeding after a natural order. As men rise above their lower grade and mind asserts larger relative power, individuality becomes developed, self-respect is generated and self-direction assumed, the number of births diminishes. We may see some exemplification of it in our own country. A few years ago some of us were startled by the statistical reports concerning the relative number of births among the immigrants and the native population in Massachusetts. It was found that the former were greatly outnumbering the latter, and some fears were excited lest the old Puritan stock should soon wholly disappear. Yet this is only an illustration of what is taking place everywhere in the world under the general law just stated, that fecundity is inversely as the social and intellectual development of man. As education increases and the mental and moral predominate over the animal, the fecundity decreases. It is doubtless

*In Great Britan we are informed that the number of land owners has diminished within a little more than a century from two hundred thousand to seventy thousand as some authorities say, or according to others to less than forty thousand.

in accord with this law that we find the most eminent men leaving few or no children; for instance Alexander, Julius Cæsar, Napoleon, Gœthe, Shakespeare, Washington, etc. The British peerage affords further illustration. "Twenty years ago," says Carly in 1858, "the number of peers was three hundred and ninety-four, of whom no less than two hundred and seventy-two were the result of creations subsequent to 1760. From 1611 to 1819 no less than seven hundred and fifty-three baronetcies had become extinct; and yet the total number created had been less than fourteen hundred." The same tendency is observable among the aristocracies of other nations, ancient and modern.

Dr. William Elder forcibly sets forth some of the reasons of this tendency as founded on physiological principles.* The discussion is interesting and instructive, and altogether plausible, covering the whole grounds of, and making provisions for, the apparent exceptions noted above in the hunter and pastoral tribes. But it is not necessary to seek all the philosophical grounds of the law in question. We should certainly be warranted *a priori* in presuming that a wise Providence would so adjust the relations of sustenance and population that the increase of the latter would gradually diminish as it approximated the possible limits of the former, and that when these limits were reached, it would wholly cease. That there are so many facts which go to corroborate this presumption and so few making against it, which cannot be otherwise accounted for, ought to give some force of conviction of its truth. Clearly enough, nature intended that men and women should marry and multiply and replenish the earth, and that for all who follow this Divine ordering there should be sustenance provided, and that she will adjust the relations of the two without any artificial intermeddling of man. If there is at any point a derangement in these relations, such as to work destruction or distress to any portion of the population, it is

* QUESTIONS OF THE DAY: Economic and Social. Philadelphia, 1871.

because nature's laws have been broken, not because they have been obeyed.

The question of the diminishing ratio of sustenance to population demands particular consideration. It is difficult to apprehend the grounds upon which this principle is based. Mr. Mill, who strenuously insists upon the law of decreasing ratio between the agricultural product and the amount of labor, to which he has perhaps been the first to give a clear and comprehensive statement, himself admits the existence of an agency in habitual antagonism to it; namely, the progress of civilization, or the improvements by which the products of labor are so greatly multiplied. This, if I understand him correctly, operates more effectually in the mechanical industry than in agricultural, and thus makes up a part of the lack which relative diminution of produce from the soil creates; but not so much as to make the means of subsistence keep pace with the natural increase of population.

Now it may be true that of a certain portion of land, say ten acres, or as much as one man can cultivate successfully, if two men should labor, the product would not double, though this would not always be the case. At any rate, the limit would some time or other be reached beyond which doubling the labor would not double the return. But this would, contrary to Mr. Mills' supposition, indicate "a very advanced stage in the progress of agriculture," at least, it would imply a cultivation of the soil such as no country, as a whole, has ever yet nearly attained. I suppose that few would doubt that more than double the present amount of produce might be effected on the soil of Wisconsin already under cultivation, and that, too, with less than double the present amount of labor bestowed. But then the most fertile soils have not yet been brought under cultivation; they are such as require for their subjugation a very considerable advance in society and in the art of agriculture. Probably the state of Wisconsin is not to-day yielding one-twentieth part of the returns of which it is

capable with no more than ten times the labor now bestowed upon it.

But there is another condition of productiveness left out of sight by Mr. Mill. Purely agricultural communities the world over are almost certain to exhibit not only a diminishing ratio between the agricultural product and the labor bestowed, but an actual diminution of products of the soil. In our own country, on lands formerly yielding thirty bushels of wheat to the acre, the returns at present are less than that, as in Western New York and Ohio. In our own State of Wisconsin the same deterioration is observable. The reason of this is that the wealth of the soil is exhausted by the exportation of raw products, and however true it may be theoretically that the fertility of the soil may be kept up by proper appliances, these appliances are almost certain never to be made. It is only where there is considerable proportion of the population engaged in other occupations besides that of agriculture that the soil is kept up to its original productive power or can duplicate and reduplicate that indefinitely.

In Massachusetts there are hundreds of farms which now produce several times their former capability, and, so far as we can judge, with far less than the proportional outlay of labor. The same is more conspicuously the case in England and France and Belgium, in the communities where, by reason of the vast diversity of employments, a large proportion of what is taken from the soil is returned almost immediately to it. It is not perfectly clear whether those who talk of the pressure of population on sustenance mean by the latter only *food*, or whether they mean to embrace, also, clothing, shelter and some other materials of human well-being. If the latter, then it is evident that the increase of sustenance in very many of the most populous communities of the world greatly outstrips that of population, even after a considerable advance in the art of agriculture. It is certain, moreover, that, up to the present time, in no country where a wise industrial and eco-

nomical system has prevailed has the increase of population outrun the increasing capability of the soil to support it. In Belgium, where the density of the population is probably greater than anywhere else in the civilized world—four hundred and thirty-three to a square mile, or more than one to every arable acre in the kingdom—with a very defective social system, sufficient food is produced from the soil to supply all its own habitants and afford a surplus for exportation—this, too, in what was originally one of the most sterile countries in Europe. France, with a density of one hundred and seventy-nine to a square mile, feeds all her own people and has food to spare. The agricultural productions of France have more than doubled within the last forty years, while, as we have seen, at her present rate of increase, it takes two hundred and seventy-seven years for her population to double. This does not appear as though population were pressing very closely upon subsistence in France. Great Britain seems to be almost the only country in which there is any alarm concerning the relations of population to subsistence, yet Great Britain is capable of producing far more than food enough to supply her present population but for the system of economy encouraged by her, which subordinates agriculture to trade. Mr. Mill himself shows, with great conclusiveness, how greatly superior is the French system of peasant proprietors, by which the land is divided up into small farms. It was claimed by some British economists, that this measure, which, I believe, began to be adopted before the revolution, and was more fully carried out subsequently, would result in a vast increase of the population, because as it would at first render sustenance more abundant for the lower classes, it would thus remove the motive to self-restraint, leaving them to multiply, as it was forcibly expressed, "like rabbits in a warren." He shows that after half a century of experiment the effect is of a directly contrary character. We have seen above that the increase of population in France is insignificantly small in

comparison with the increase of food supplied from its own soil.

A source of error which has helped to support the doctrine here combatted exists in the assumption that the most productive lands are first occupied, and then those that are poorer, and so on down to those whose cultivation will barely sustain life. If this were so it would almost inevitably follow that the increased labor necessary to secure a given amount of product from the inferior soils would imply the truth of the doctrine. But it is evident that in the infancy of society when the numbers are small and the facilities for cultivation few, only the lands easily cultivated can be occupied, and there must necessarily be the lighter and less productive soils. Up to their time even in the oldest civilized communities, some of the most productive lands have not yet been brought under cultivation, while as in Great Britain, within the last twenty years perhaps the most beautiful crops in the whole country have been taken from lands which previously were considered almost valueless.

The statistics of the most advanced nations do not at all indicate this disparity between increase of population and the means of subsistence. In the United States the increase of population from 1850 to 1860 was 35.5 per cent., while the wealth of the country, real and personal, excluding that in the slaves, increased 86 per cent.; or the capital wealth of the country grew at the rate of 8½ per cent., and the population at that of a fraction over 3 per cent. per annum; the average share of each individual in the whole wealth of the country, were it equally divided, being in 1850, $266, and in 1860, $449; being an increase in ten years of 69 per cent. to each person. The siatistics of the last census present still more astonishing results. The "true value" of the real and personal property of this country in 1860 was in round numbers $16,000,000,000. In this was included the value of slaves who in 1870 owned themselves, and so were not reckoned as property. Aside

from these the "true value" may be put at $13,000,000,000. In 1870 it was as given by our census tables $30,000,000,000, giving an increase greater in the last decade by 30 per cent. than the total previous accumulations since the first settlement of the country by Europeans; this, too, in a decade of unparalleled public and private expenditure, of immense waste and destruction of both laborers and their products. This would give nearly $1,000 a piece to every man, woman and child in the whole country, an increase of more then 100 per cent. over the average portion of each at the beginning of the decade.*

In France in the decade ending in 1860, the increase of population was 2.6 per cent.; the increase of annual product 44 per cent., and the average share of each inhabitant in the annual products was 40 per cent. greater than in 1850. The increased value of each acre's share in the total wealth is supposed to have been considerably greater than this, but the statistics are not at hand.

In Great Britain the average of the total values of the property of the kingdom to each person were in 1851, $827; in 1861, $1,074; and in 1866, $1,239, being an increase of 50 per cent. in fifteen years. So that in Great Britain it is not because there is less increase of means of subsistence than of population that there is danger of starvation and need of preventive checks, but because there is somehow an inequitable distribution of the products of labor.

The following proposition will answer for a brief summation:

*Exceptions have been taken to the above statistics and to the inferences likely to be drawn from them, on the score of the decrease in the "purchasing power" of money. Probably some modification should be made on that account, but not nearly so much as has been thought by many. The vast increase of gold and silver within the last twenty-five years, and the inflation by means of paper currency in the last ten, while changing the money price of many articles of ordinary traffic, has not left the values of some of the more permanent kinds of property as measured by money, nearly unaltered except as due to other causes, as the latter are many times greater than the former, the probability is that the variation to be made in the estimate is comparatively moderate.

1. In regard to population and sustenance, nature works as everywhere else, in harmony with herself and for and not against the increasing prosperity of the race.

2. Up to the present time, in every healthily ordered community, all increase of population has been accompanied by still larger increase in the productiveness of labor in agriculture, in the mechanical arts and in the emancipation of mind from the dominion of matter.

3. Whatever remote limit there may be to the capability of the earth to afford subsistence, and whatever may have been the rate of increase of population, it is evident that the increase of sustenance hitherto has been greater than that of population; and that in the order of nature they will adjust themrelves to each other without artificial restriction or destructive checks.

4. Notwithstanding the crowded condition of some localities and the vast population of the globe, only a comparatively small fraction of the earth's capabilities of support for man have yet been exhausted, and if humanity is anywhere a drag or a nuisance, it is because the animal in it prevails over the rational and the spiritual.

5. The increase of individuality and of association is the one essential instrument to the upward and forward movement of the race. This depends upon the largest practicable diversity of industry, the bringing of men into the most intimate commerce with each other, rapid societary circulation, and all possible facilities of education and development.

RECORDS OF MARRIAGES.

BY REV. F. M. HOLLAND, A. M., BARABOO.

Records of marriages are primarily designed to furnish proofs of the fact, but they might also be adapted to giving valuable statistical information. The present method of making such records in Wisconsin seems capable of improvement in both respects.

Whoever solemnizes marriage in this state is required to deposit with the county register of deeds, a certificate stating the time and place of marriage, the full names of both parties and of their parents, and also the occupation and place of birth and residence of the man, though not of the woman. Probably the legislators thought that women did not have any occupations, but it rather looks as if they were beginning to have some, to say the least. Women certainly have places of residence, and also of birth, the record of which latter might much assist the student of statistics by informing him which portion of the marriages are between foreigners, what between native-born Americans, and what between an American and a foreigner. Such a record would also become much more valuable as legal proof.

Both objects would be yet more promoted by inserting what has been wholly overlooked, but is peculiarly needed for both legal and statistical investigations, namely a record of *age*. This would plainly assist identification. Social science, also, needs to know whether our people marry earlier or later in seasons of unusual prosperity or adversity, and also what occupations and nationalities are most prone to early matrimony. The question whether the American, or rather Anglo-American, race is dying out would be much enlightened.

It might, also, be worth while, in view of the presence of negroes and Indians, to make some record of race, though this would probably not be done with sufficient accuracy, until a change, described below, is made in the parties making such records.

The present law makes a poor apology for records of race and nationality, in requiring that of *color*. This provision is merely a relic of wicked prejudices, which the blood shed in our great war should have washed away. In the name of Abraham Lincoln, John Brown, and the countless other martyrs for universal liberty, let us cleanse our records of such stains. Social science recognizes the distinction between negro or Indian, and Anglo-American, as she does that between Anglo-American, German, Celtic and Scandinavian. The distinction between white and black is not scientific but barbaric.

The word "color" should therefore be exchanged for the word "race," or entirely omitted. Indeed the mere substitution of the word "age" for the word "color," would be a great practical benefit, and should, in the opinion of this writer, be secured during the present session of the legislature by a committee appointed for the purpose by this Academy.

Such a committee might consider what record should be made of nationality, and whether some record should not be made of the wife's birth-place, residence and occupation.

The attention of such a committee, as well as of this association, may also profitably be directed to the fact that ministers are now required to certify that a marriage has been *consummated* by them. The statute, indeed, uses invariably the proper word "*solemnize*," but the printed form substitutes the word "*consummate*," which could not be properly applied to any act of the minister, and has a special usage in reference to acts of the parties married.

The writer has been accustomed to correct this error in his own certificate, and now asks that this correction be made in all the authorized forms. It is unworthy of the state of Wis-

consin to require clergymen to make out certificates in bad English.

It is further worth considering whether it is the proper business of clergymen and justices of the peace to make out such certificates for record in any form, and whether it would not be better for Wisconsin to do like other states and require all parties desirous of committing matrimony to obtain a license from the county clerk, who shall biennially make a record of the full names of parties and parents, as well as of age, occupation, residence, birthplace, and nationality of both bride and bridegroom. The clerk might then, if satisfied that the parties were legally entitled to marry each other, give them a license, which would be returned by the minister, who would simply note down the time and place of the ceremony. The clergymen of Wisconsin would be much indebted to this association for relieving them of the present necessity of acting as police magistrates and detectives. At present, ministers have practically to marry almost anybody that applies to them, a custom greatly favoring runaway matches. Indeed, Wisconsin marriages are becoming a proverb in adjoining states. This is made still worse by the conduct of ministers themselves, in occasionally omitting to make proper returns, when so requested by the parties. The writer was twice invited to solemnize marriage without making the returns required by law. In both cases he refused. In one case the parties finally gave consent, but in the other a more accommodating parson was easily found. But if both bridegroom and clergyman were liable to be fined heavily for lack of a license, they would certainly have one, as the minister would insist upon it for the bridegroom's sake as well as for his own, and before it could be obtained all needed opportunity for making full records would be given to the most competent person, the county clerk or register of deeds.

These officers might then be required not only to keep a general record, setting down the ages of parties married, in

parallel columns with their occupations and nationalities, but also annually to return abstracts to the secretary of state, who might then issue condensed statements which would be highly useful to students of social science.

Whether this Academy should take any steps toward so materially altering our whole system of matrimonial records is one question. It is quite another whether its members should at once agitate the omission of the word "*color*," the insertion of the word "*age*," and the exchange of the phrase "*consummated*," for "*solemnized*," in the existing forms of record, and whether these forms should not mention the occupation, birthplace and residence of the wife as well as of the husband. Possibly a statement whether previously married or unmarried, might also be required with advantage.

THE EFFECT OF DUTIES ON IMPORTS UPON THE VALUE OF GOLD.

BY JOHN Y. SMITH, ESQ., MADISON.

That the paper currency of the United States is depreciated below the common money of the world—gold and silver—is universally admitted, and the cause generally recognized, viz; the excessive quantity of paper in circulation. It is also a fact well understood by every careful student of economic science, though not so generally understood by others, that the nominal premium of gold over paper, as it has existed for several years past, does not mark the true depreciation of the paper. A careful comparison of present general prices with those of ante-war times, fourteen or fifteen years ago, demonstrates that gold itself, in this country, is depreciated even farther below its value in other countries than our paper is below our gold.

Thus far economists see their way clear, and are substantially agreed. But what is the cause and what the extent of this depreciation of gold, are problems which they have not yet been able satisfactorily to solve. Prof. Perry and others have attributed this depreciation to the demonetization of gold in this country. It is true that if we impair the utility of an object we depreciate its value; and as gold derives most of its value from its use as money, if gold were universally demonetized, the greater part of its value would be destroyed. If a small portion only of the general stock of the world is demonetized, only a correspondingly small portion of its value will be destroyed. The little gold which we have demonetized has long since been exported and distributed itself throughout the commercial world, adding a trifle to the specie volume of all other countries. In accordance with the law of money, that as its total quantity

is increased (other things remaining the same) the value of a given quantity declines, the entire stock of gold in the world has thus been slightly depreciated. From this cause, therefore, it has been depreciated as much in other countries as in this. The rule for determining the general depreciation from this influence is very simple. Assuming that gold derives seventy-five per cent. of its value from its use as money, and that we have demonetized one twenty-fifth part of the entire stock of the world, the depreciation from this cause will be four per cent. of seventy-five per cent., or three per cent. of the whole. Considering the large amount of gold still held in partial circulation by the demands of the government, it is not probable that the amount actually demonetized exceeds the fiftieth part of the world's stock, and that the consequent depreciation does not exceed one and a half per cent. But the relative depreciation in this country, as compared with other countries, is nothing at all, and it is the relative depreciation which we wish to account for.

Some economists think that the duties on imports have *something* to do with this relative depreciation, but how much and in what way the effect is produced, they are unable to determine. I think it is susceptible of scientific demonstation that the depreciation is wholly the result of these duties, and that the extent of the depreciation is just equal to the average rise of prices on all importables and exportables added together.

As we proceed with this demonstration, we must endeavor to gain and keep in mind a clear and accurate conception of the nature of *value*, which is often confounded with other things or qualities which are quite distinct from it. Some confound the value of a thing with its *quality*, and as the quality of pure gold, wherever found, is always the same, they conclude its value must be equally immutable. Others confound value with *utility*, while utility is only one of the *elements* of value, always present, but rarely determining the

value of anything; *that* being determined, almost always, by the other element of its existence, namely, *resistance*, or the difficulty to be overcome in obtaining it. The brilliant Bastiat defines value as "*accumulated service.*" This is much like calling a snow-drift accumulated wind, and is quite too great a stretch of poetic license to answer the severe demands of scientific accuracy. A large class, including some able writers on political economy, regard value and *wealth* as synonymous and convertible terms. But *wealth* consists of the aggregate of exchangeable objects, while *value* is simply the *ratio* in which those objects exchange, or are exchangeable for each other, and is not necessarily dependent upon their aggregate quantity. Let us bear in mind, then, as we proceed, that *value is the ratio of exchange between different objects, money included.*

To avoid unnecessary complications we will, for the present, entirely ignore the existence of paper currency and deal only with the money of commerce, consisting chiefly of gold. Under the natural conditions of commerce—free trade—each country will retain, with slight oscillations, just that proportion of gold which will hold the average prices of its importables and exportables aggregated, at very nearly a uniform level throughout the commercial world. If any one country has even a slight excess over this proportion, prices there will become relatively cheaper than domestic products, and more goods will be imported than its exports of goods will pay for, and the balance will be paid in gold, until, through the contraction of the gold volume thus effected, prices of domestic products are again brought down to the common level in other countries, and then the *efflux* of gold will cease. If the country has *less* than this proportion, domestic prices will fall and foreign goods will become relatively dearer than domestic goods, and the demand for the former will decline until the imports (other than gold) will no longer balance the exports and the balance will be brought home in gold until the vol-

ume of gold and, consequently, domestic prices are again brought up to the common level in other countries, and then the *influx* of gold will cease. This point where the exports and imports just balance each other, is what Mr. Mill happily calls "*the equation of supply and demand.*" This law of trade is just as immutable and invariable in its operation as any law of chemistry, as every economist knows. Owing to the complicated transactions of commerce, it is impossible for commercial sagacity to adjust those transactions to the exact line of this equation. They are constantly oscillating across it, like a pendulum across the center of gravity, but never varying very widely from it, on either side; for the moment the slightest deviation is detected, commercial self-interest is prompt to apply the corrective by importing more goods and less gold, or more gold and less goods, as either one becomes more profitable than the other—the one which is most profitable being always the right one to restore the equation of supply and demand. Wherever gold will buy less than it will elsewhere, there it is depreciated just to the extent of the difference, and if unobstructed by artificial barriers, elsewhere it will go till the difference no longer exists.

Now suppose a country places obstructions in the way of commerce in the form of heavy duties on imports, as our country has done. What will be the consequence? Undoubtedly the price of all importables, that is, commodities imported and all domestic products of the same descriptions, will be forcibly raised to the extent, or very nearly to the extent of the duties imposed, except where the duties are so high as to become prohibitive; while the prices of exportables, that is, all domestic products of which we raise a surplus for exportation, whether exported or consumed at home, will still be governed by the foreign market and remain the same as before. The consequence will be a rise of average prices above the average prices in other countries where these obstructions to commerce do not exist, and the advance of average prices will continue

as long as the obstructions which raised them above the common level continue. Average prices being thus raised and held there by arbitrary means, as water is held by a dam across a stream, more money than before will be required to effect the exchanges of the country; for it is a very plain proposition that it requires more money to buy and sell a given quantity of products at a higher range of prices than it would to buy and sell the same quantity at a lower range of prices. One of two things, then, must be done—either average prices must come down to the former level, or the volume of money must be increased. The price of exportables will not yield, to restore the former level, for that is governed by the foreign market. The price of importables will not yield, for that, both in respect to actual imports and domestic products of like descriptions, is governed by the foreign cost and the duties added. There is but one remedy left—the volume of money must be increased. How can it be done? It will be effected in this wise.

The cost of imports being largely increased, the demand for them will as certainly be diminished—not always in the ratio of the increased cost, but very sensibly diminished. The demand for exports will remain the same, because the cost remains the same, and the imports will no longer pay for them, and the balance must be returned in gold. This process must go on, and very rapidly too, until the volume of money has been raised the same per cent. that average prices have been increased, and then the equation of supply and demand will be restored upon a new and artificial basis of prices, and the influx of gold will cease. But the ratio of exchange between gold and other things will be changed. We shall then pay just that much more gold for the same things, in the aggregate, which we before bought for so much less, and so much more than we could again buy for under the natural equation of supply and demand; and keeping in mind our definition of value—that it is the ratio of exchange

between different objects, money included, our gold is depreciated by the duties on imports just that much below its natural value. In exchange for importables, the gold will be depreciated to the extent of the average per cent. of the duties upon them; but in exchange for exportables it will not be depreciated at all, so that for general purposes it will be depreciated only to the same per cent. that the average per cent. of duties bears to the total *natural* value of both exportables and importables added together. Thus: if the two classes of commodities be each represented by 100, and 45 be added by the duties, the per cent. advance on importables will be 45, but the advance on the two aggregated will be but 22½ per cent.

To determine what the advance is in average prices and the resulting depreciation of gold, is a difficult problem only because of the difficulty in ascertaining the exact value of importables and exportables, respectively, the extent to which they are respectively subjects of exchange, and the extent to which exchanges of real estate, which is neither exportable nor importable, may modify the result. By reference to accredited statistics we may, however, arrive approximately at least, at the true depreciation of gold from the cause stated; the object of this paper being rather to develope a principle than to arrive at exact results from its operation.

The average per cent. of duties on imports, as determined by dividing the total amount of revenue derived from them by the total amount of imports, is about 45 per cent. This per cent. (with slight modifications) is added to the price of all importables, whether foreign or domestic. Now what we wish to know is, what per cent. this adds to the average price of importables and exportables aggregated.

According to the census returns for 1870, the total valuation of manufactured products, deducting $90,000,000, the product of mines, and adding $462,277,587 of actual imports is.....	$4,604,703,029
Deduct from this the tariff element in the valuation (45 per cent.....	2,072,116,363

Leaves as the natural value..... ..	2,532,586,666
Value of farm products (exportables).....	2,447,538,668
Natural value of both.....	$4,980,125,324

Divide the tariff element in the valuation of importables by the total natural value of importables and exportables added together as above, gives about 41 per cent. as the average advance in prices and the true depreciation of our gold. Lest this result should appear too startling, it should be remarked that this is the true depreciation from the absolute free trade standard, or, normal state of commerce. By this rule, the present depreciation is about 33 per cent. below what it would be under a strictly revenue tariff, averaging say 15 per cent.

This explains how it is that the country has been able, for the last four or five years, to float such an enormous amount of paper so nearly at par with gold; when, in 1857, only about twelve years before the gold premium settled down to about its present figure, two hundred and fourteen millions of paper was sufficient to drive all the gold out of the country and produce a general supension of specie payments. Now, the paper volume is seven hundred and fifty millions, and has been for years past, and at an average discount of only about twelve per cent. Many of our statesmen, or rather I should say politicians, pretend to believe that this is the result of the national growth and developement of the country. But no rational man can believe that the country, in twelve years, has advanced three hundred per cent. in population, wealth and exchanges, with four of those years devoted to the most destructive war of modern times, when about twenty per cent. has been the usual advance in a decade, in peaceful and prosperous times.

I am aware that this law by which gold is depreciated by duties on imports, seems to conflict with the general law which causes gold to flow from where it is worth *less* to where it is worth *more;* for, we have seen that, pending the adjustment of the volume of money to the forced increase of average

prices, gold actually flows from where it is worth *more* to where it is worth *less*. In a correspondence on this subject, which I had with Prof. Perry of Williams College, this apparent conflict with a well established law, was what staggered him as to the soundness of the principle I have endeavored to develop. But this conflict is only in appearance; for, although the gold imported to raise the volume of money to the new volume of prices, is actually depreciated below its general commercial value, still it is worth more to *us* than the foreign goods we would get instead, clear of the custom house. The demand for our exports, we have seen, is not diminished by the duties on imposts, and we must import *something* in exchange for them, or give them away. Give them away we will not, and in importing gold in preference to goods, we only choose the better of two bargains, either of which is bad enough.

The elements of this calculation are liable to some modifications, both in the direction of a greater and of a less depreciation; the *greater* from the vastly larger proportion of farm products which are consumed by the agricultural population and never become the subjects of exchange at all, than can be predicated of manufactured products; which will considerably reduce the agricultural element in the total of exchanges and make the average rise in prices and the depreciation greater; and then the *less*, as money used in the transfer of real estate will add to the volume of non-importables and tend to *diminish* the average per cent. of prices and depreciation. But it is probable that these opposite tendencies will nearly balance each other, and leave the results I have arrived at not very wide of the practical truth.

Thus far we have reasoned upon the assumption of a purely metallic medium of exchange. Will the introduction of paper currency change the result? Not in the least. If a local currency exists in the meantime, equal in volume to the gold which would otherwise have been imported and held in the

country, the same results will be arrived at without any influx of gold at all, and the little gold remaining in the country will be depreciated in the same degree as if the circulation had been all coin—the high duties acting as a strong inducement to import gold, and the paper currency acting as an equally strong inducement to export it—the two antagonistic forces just balancing each other. If the paper volume, in the mean time, is *greater* than the gold volume would have been, with no paper, the tendency to import gold, produced by the duties, will not only be balanced, but *overpowered* by it, and gold will flow out just so long as there is any in the country not held back by arbitrary means. This latter state of things has existed in the United States ever since the commencement of the civil war. The paper volume has all the while been in excess of what the gold volume would have been without any paper, and, of course, gold has all the while been flowing out of, instead of into the country. Our gold, then, as compared with its value in other countries, is depreciated a little more than forty-one per cent., estimated upon a free trade basis, or a little less than thirty-four per cent. estimated upon the basis of a strictly revenue tariff, and our paper currency, by its enormous volume, is depreciated ten to twelve per cent. below that, making the total depreciation of our currency, upon the one basis, about forty-five per cent., and upon the other, about fifty-three or four per cent.

The foregoing facts and principles have an important bearing upon the financial and commercial policy of the country, if it is ever again to have a policy. The country is now suffering both from a depreciated, irredeemable currency, and from an exorbitant monopoly tariff, and the signs of the times indicate a determination on the part of the people to rid themselves of both as speedily as possible. But can we with safety get rid of both at once and *all* at once? Let us see. The depreciation of the currency, as we have seen, is *compound*. The paper is depreciated eleven or twelve per cent. below the

gold in the country, which is itself depreciated say thirty per cent. below what its value would be under a strictly revenue tariff. So long as the present high duties are maintained, the depreciation of the gold will continue, and we will only have to overcome the present premium on gold by contraction of the paper volume to that extent, in order to maintain specie payments. But, repeal the tariff entirely, and gold in this country would immediately resume its normal value and shoot up to about fifty-three per cent. premium, and we would see just how far, between tariff and paper inflation, we have drifted with our currency, from a normal specie basis. Reduce the duties to a revenue standard, and the premium on gold would at once rise to fully forty-four per cent., and we would be compelled to overcome that by a like contraction of the currency before specie payments could be maintained. It should also be noted that, in returning to specie payments, the gold which we have demonetized must be drawn from the general stock of the world to resume its functions as money in this country, and thus the whole stock of gold will be appreciated in value as much as it was depreciated in the process of demonetization, and will add one, two or three per cent., whatever it is, to the depreciation of our currency, and which must be overcome by contraction. Such a contraction, even if extended through a whole year, would doubtless be seriously felt by the business interests of the country, though it would be trifling compared with those which used to occur under the old bank suspensions, when the currency was contracted, sometimes to the extent of fifty or sixty per cent. in sixty days. I am satisfied that much of the dread of contraction results from the memory of the violent and sudden contractions of 1837 and 1857, which sprung like a steel trap upon its unsuspecting victims. But contraction is an absolute necessity if we are ever to return to a specie basis. True, some politicians, who pass for statesmen, talk of resumption without contraction of the paper volume; but a tyro in eco-

nomic science knows that this is as impossible as for a man to walk across the Atlantic with a crowbar for a walking stick. Any attempt of the kind would result in another suspension in less than sixty days. It would at once add 11½ per cent. to the profit on the exportation of gold, and the gold would disappear as fast as it could be counted out. To resume without contraction and at the same time reduce the tariff to a revenue standard, would add forty-four per cent. to that profit, and how long would resumption last then? And yet the country is beginning to demand a return to a specie basis and reduction of duties on imports to a revenue basis, and that demand will become more and more imperative. Both can be accomplished without serious disaster; but, in order to do that, the currency must be contracted and the duties reduced by *regular installments*, in pursuance of a steady and persevering policy, regardless of the clamor of bankers and speculators. A contraction of ten per cent. a year would bring us to a specie basis, under a revenue tariff, in about four years; and if business men could know that such a policy would be inexorably carried out, they would regulate their business accordingly and steer clear of disaster. A contraction of five per cent. a year, steadily pursued, would accomplish the same objects in eight years, and scarcely be felt at all. The latter policy would perhaps be the better one, if we could depend upon our government to maintain any definite policy for that length of time. The danger is that it would be reversed before the end could be accomplished. Inflation is easy and contraction is hard. It is easy to jump down from the top of a tower, but not so easy to jump back again. The misfortune is that many of our statesmen (?) propose, as the shortest way to get back, to jump down a precipice at its base—to arrive at resumption by way of further inflation! Many others of them propose to *drift* back—to wait for the country to *grow* to the present paper volume; while the very few who have taken the pains to qualify themselves for their business, and

know what the difficulty is and how to remedy it, are either dragged down by the jumpers or overwhelmed by the drifters, who persistently refuse to learn anything from the laws and history of finance, the experience of other countries, or even of our own country. They will grant that two and two make four in the old countries of Europe, but insist that this great republic is so different from all other countries in the world, that, here, two and two will make five, or seven or nine—anything you please, except four! And thus they drift on in complacent imbecility, without chart or compass or rudder, they know not whither.

REQUISITES TO A REFORM OF THE CIVIL SERVICE.

BY DR. J. W. HOYT, PRESIDENT OF THE ACADEMY.

If it be true, as asserted by the civil service commission of the United States, that the present system of the civil service "violates the fundamental principles of thrift and economy; fosters personal and political corruption; paralyzes legislative honor and vigilance; weakens and degrades official conduct; tempts dangerous ambition; and, by poisoning the springs of moral action, vitiates the character of the people and endangers the national prosperity and permanence," then is it a matter of the most vital importance to the nation, and to the republican principles upon which the government is based, that we accept it as truth and devote our best thoughts and energies to the reformation of that service.

Unhappily, there is nothing in the results of inquiries instituted by the civil service commission, nor yet in the facts recently brought to light by the investigations of committees formed by the state and national legislatures, that is calculated to disprove these grave charges. It is true that the civil war, through which the nation has so recently passed, may be held responsible, in large measure, for the corrupting influences which have so infected the body politic and tainted the political atmosphere of the country. This is one of the legitimate fruits of all wars, one of the terrible penalties a people must suffer for yielding to the impulse of passion instead of holding themselves bravely to the demands of reason. But far more of this political demoralization is chargeable against our system of the civil service. And if, on the one hand, we are filled with alarm at the revelations made from time to time of the extent to which these corrupting agencies have done

their fearful work, we have just cause, on the other, to congratulate the country and the friends of republican institutions everywhere, that the patriotism and morality of the country, acting through the thoughtful, earnest and pure men of all sections and all political parties, have already begun the great work of purification.

A further ground of encouragement is found in the fact that this reform did not have to wait for its inauguration until universally demanded by an indignant people, but originated in an appeal from the chief magistrate of the nation, clothed in these words:

"Always favoring practical reforms, I respectfully call your attention to one abuse of long standing, which I would like to see remedied by this Congress. It is a reform in the civil service of the country. I would have it go beyond the mere fixing of the tenure of office of clerks and employees who do not require the advice and consent of the Senate to make their appointments complete. I would have it govern, not the tenure, but the manner of making all appointments. * * * * The present system does not secure the best men, and often not fit men, for public places. The elevation and purification of the civil service of the government will be hailed with approval by the whole people of the United States." [Message of 1870.]

The promptness with which congress seconded these views of the president and gave him authority to appoint a commission charged with the duty of devising a plan under which the needed reform should be inaugurated, and the readiness with which he adopted the recommendations of that commission and sought to give them efficiency,—these circumstances have so enlisted the sympathy and support of good men throughout the country as to have warranted the hope that the reformation will steadily go on to its completion.

It matters not so much that many friends of the object sought to be accomplished criticise and condemn some of the details of the plan adopted by the commission; much less that selfish demagogues, who see in it a curtailment of their prerogatives, hold up its weak points to public ridicule. The plan

recognizes and embodies important principles, which cannot be contemptuously treated, which are sustained by reason and have stood the test of long-continued and faithful trials in other countries.

It is no longer the rule that the clerkships in all the departments at Washington are filled by favorites of senators and members of congress, with little regard to fitness, as had been the case almost since the foundation of the government. Under the present regulations, requiring notice of vacancies and impartial competitive examination of all candidates, it is manifest: first, that merit, and not mere party and personal subserviency, is to be the prime consideration in the selection of persons to do the work of the departments; and secondly, that in proportion as these regulations are perfected and faithfully enforced, we have a guaranty that this work will be *well* done.

But the civil service commissioners have been charged with only a small part of the work of reform, which, viewed in its totality, is as comprehensive as it is important, involving a necessity not only for legislative action, but also for modifications of state and federal constitutions.

As the subject presents itself to my mind, the requisites to a thorough reform of the civil service of the country are these:

I. A judicious and faithful application of qualification tests in the case of all offices filled by appointment.

The work of the United States civil service commissioners, as already observed, is limited to a few subordinate places in the executive departments; whereas, the principle should have a much wider, indeed a general application.

Objections may with propriety be urged against filling some of the higher government offices by open competitive examinations; the chief of such objections being, that the duties performed by the incumbents of them are not routine and largely mechanical, as in the case of a majority of clerk-

ships, but largely administrative, and hence demanding such high natural qualifications as must be personally known, either to the officer having the appointing power, or to persons of his acquaintance whose recommendation is a guaranty of capacity and trustworthinss. But no objection can be urged against the right of the people to demand that all appointments, even the highest, shall be made on the principle that ability, integrity, special adaptation, and special attainments wherever essential to a proper discharge of the duties devolving on the appointee, are absolutely essential, and hence paramount to all considerations of mere party relationship or partizan service. Such right is undeniable, and the only reason it is not exercised is, that, on the one hand, there is a lack of appreciation of it, and, on the other, the potent influence of party prejudice and party interest. As a consiquence, most unfit men are found in all branches of the civil service. United States judges, unsited to the responsibilities of the bench; foreign ministers, without the slightest knowledge of diplomacy, scientifically or historically considered; consular agents, without any idea of consular duties or even of the language of the country to which they are accredited; and even heads of executive departments, sometimes chosen with less reference to special fitness than to influential standing in the political party of the administration.

Here is a vast and immensely important field for civil service reform, in which the executive is supreme, one in which, practicing on the principle, "country first and party afterwards," we may do a great deal to promote the welfare of the country and establish the world's confidence in the wisdom and economy of republican institutions.

II. A second requisite is the making the tenure of all such offices as require special preparation and considerable experience for the proper discharge of their duties, conditional, not on party affiliations merely, but on demonstrated ability and fidelity.

The theory long practiced by successive administrations, but first sanctioned, if not formulated, by President Jackson, this, namely, "To the victor belongs the spoils," is demoralizing and dangerous. It places party before country, discourages laboriousness of preparation for, as well as faithfulness in, office, and puts a premium upon trickery and rascality in the conduct of every political canvass. Contending under this banner for the mastery, the citizen is lost in the partizan, and the idea of sacred trusts gives place to the idea of public plunder. It is the very system to breed a race of thieves, as is shown by both reason and experience. And yet it is a most difficult system to overthrow, for it is rooted in human selfishness, and has been so long nourished, that it is now of rank and giant growth. But its overthrow is possible, and great will be the reward of that party or administration which shall bravely and resolutely enter upon this patriotic work.

III. There should also be adopted some equitable system of promotions and other rewards wherever practicable.

In the army, we have a career for the soldier; he knows that although he should enter the service as an obscure private, there is before him a line of promotion, which, if he can but once enter upon it, is as sure as life and good behavior to lead him upward, and may eventually place him in the supreme command. But in the civil service, upon whose skilful and faithful administration the welfare and security of the country no less depend, we have as yet no career. The man whom pecuniary circumstances may have constrained to secure for himself a subordinate position in one of the departments, but who possesses rare qualifications for that or even a superior position, and who, by long experience and close attention to his duties, has fairly entitled himself to the grateful recognition of his chief, has hitherto been doomed,—unless able to bring powerful party influence to bear for his advancement,—to see inexperienced and possibly totally unfit persons

appointed to positions above him and directly in what ought to be the line of his own promotion. That such a course of injustice—injustice to both the individual and the government—must be highly injurious to the public service is plainly manifest. Something has been done towards remedying the evil by the civil service commission. It has at least done good service in calling public attention to the principle, and in securing for it some degree of practical recognition.

It may also be well to inquire whether there could not be adopted yet other methods of rewarding services of extraordinary merit. In the military service, we have brevets, bounties, pensions, etc. Is there any good reason why corresponding rewards should not be provided for specially meritorious services in civil departments of the government?

IV. There should be an increase in the legal or constitutional term of many offices.

This would—

1. Encourage able and good men to accept office who now stand aloof because they are unwilling to break up present business relations for the questionable advantage of a very brief term of public service.

2. Discourage mere adventurers and worthless politicians in the same proportion, since it would have the effect to make all conscientious and intelligent voters more scrupulous and exacting.

3. By diminishing the frequency of elections, tend to cure the present thirst for political excitement and the mania for political office, now become a most prominent evil of the times.

4. As a consequence, correct that absurd practice of frequent *rotation*, which is based on the false theory that office is a perquisite of citizenship, a thing for the individual, and not for the government and the common good of the whole people to be affected by it.

This requisite to a reform of the civil service deserves there-

fore to be urged upon the country with great force and persistency. We are already a nation of politicians—politicians, too, in the most objectionable sense; by which is meant a great body, a mighty host, of place-hunters, hungering, panting, scrambling, fighting, each for his share of the spoils of office. With an alarmingly large and increasing proportion of the people, an ordinary legitimate business, yielding a comfortable living, is unsatisfying, and to be escaped if possible; and as for downright labor, that is contemptible!

Of those who are politicians in the better sense, the great majority are almost totally ignorant of political science, while the number is by no means small of those who openly scout the idea of there being any such science. As to statesmanship, that is a thing of which we hear much talk but see few illustrations. What wonder that so much of our legislation is botch work, requiring to be torn to pieces and done over again and again, in the vain attempt to accomplish the desired object. How can it be otherwise, when each successive legislature or congress is composed, for the greater part, of men who have neither knowledge of the principles of political science, nor the advantage of legislative experience—composed, in a word, of raw recruits, whisked off, with short warning and no preparation, from the field, the workshop, the factory, the counting-room, or the professional office, and required to devote themselves, for the space of a few months at the most, to the settlemnt of a thousand and one questions, a majority of them entirely new, and some of them gravely important, requiring years of the most careful research for their solution?

The same is true of offices other than legislative. The term, as a rule, is too short, and changes are too frequent. In most of the states the governor and other state officers are chosen once in two years; and although re-eligible, it is quite as often as otherwise that they remain in office but one term. Not because of neglect of duty or malfeasance of any sort, but because some one not in office is bent on having his turn! And

so it is, that, with annual local elections, biennial state elections, and quadrennial national elections, we manage to have nine-tenths of the most important offices filled with inexperienced men, and to keep the whole body of the people in a fever of excitement and under the play of demoralizing influences from the beginning to the end of their lives.

But for this state of things, or in other words, if the people were always capable of acting wisely and calmly in the selection and support of men to represent them in official positions, so that the selection of an officer conspicuous alike for ability and fidelity would depend more upon his willingness to continue in service than upon the manoeuvering of ambitious scramblers for his place, then, in that case, the necessity for an increase in the term of office would not be so urgent. But the people are not universally capable of so acting, and it is next to impossible that they should ever become so under the short-term system.

In connection with the presidency, there has been much discussion within a few years past, of the one-term principle. Able senators have urged congress to take preliminary steps looking to a change to that effect in the constitution; and at least one candidate for the presidency has inscribed the one-term proposition on his banners.

The strong argument, if not indeed the only one, employed by the advocates of this change is, that, as the provision now stands, the tremendous power of the public patronage, so much of it in the hands of the president, is liable to be used to secure his re-election, regardless of the wishes of the people of the whole country. This is indeed a matter worthy of thoughtful consideration. It seems to me, however, that the proper order of the discussion is: first, to inquire whether re-eligibility is in itself desirable; secondly, whether the objections thereto are of sufficient weight to overbalance the reasons for the present provision; and, thirdly, whether in such event, it is not possible to remove the objections without the sacrifice of any other important interest.

To the first of these questions there can be but one answer. The wisdom of the founders of the republic, the experience of our past history, and the unbiased judgment of the present time, all agree that, in a matter of so great moment, as in other matters of moment, it is best to leave the hands of the people untied, the popular will free to act in accord with the popular judgment.

The second question cannot be so easily disposed of, since it is impossible to determine the extent to which the power of patronage is ever used by the executive for the purpose of securing a renomination and re-election. As a rule, to which there have been but few exceptions in the history of the government, the high character of the chief magistrate is a good guaranty against the corrupt exercise of power for personal advantage; and as it may be assumed that an exceptional president will very certainly have favored his first supporters, by way of reward for their services in securing his first election, and hence, in large measure, have exhausted the resources of his patronage, there is reason to believe that the danger from this source is very much overrated. It is also to be borne in mind that the unfortunate experience of such of the presidents as have ventured to disregard the wishes of ther constituents has already pretty well impressed it as a conviction upon the public mind that no amount of corrupt use of patronage will be sufficient to override the popular will, when it has once declared itself with the voice of condemnation. While, on the other hand, it is worthy of mention that, of the presidents who have been re-elected, not one has disappointed the public.

The advocates of the one-term rule admit the force of the reasons that sustain the constitutional provision as it stands,—namely, the great value of experience on the part of the executive, and of steadiness in the administration of the government,—for, with one accord, they propose to couple an *extension of the term* with their limitation of the number of elections. But they appear to overlook this important consideration, that,

in order to meet the argument based on experience and steadiness by any considerable extension of the one term, they subject the country to the liability of serious injury from the prolongation of a most faulty administration. But granting, for the sake of the argument, the full force of the arguments urged by the advocates of the one-term proposition, let us see, in the third place, whether there cannot be found remedies for them less open to the serious objections above alluded to. The following suggest themselves at once:

1. The proposed general increase in the term of most offices, as a means of correcting the present tendency of the whole people to make politics a *trade;* thus, in a great measure rescuing them from the dangers of political corruption.

2. The cutting down of the presidential patronage, by providing suitable conditions on which many of the appointments shall of necessity be made,—a work already commenced by the civil service commission under the inspiration and support of the present chief magistrate,—and, possibly, by transferring the right of choice, in some other cases, from the president to the people themselves.

3. The choice of our presidents by a direct free vote of the people, or by some other method worthy to succeed the present fraud-engendering electoral-college system.

I confidently believe that, if these several remedies were applied, the evils now attending the re-eligibility of the president would be so nearly cured that the heroic and very questionable measures proposed by the limitationists would cease to be urged.

V. A fifth requisite is the re-adjustment of salaries on the basis of equity and public policy. At present, there is a great, and often very unjust, inequality. The head of an important bureau or department perhaps receives less compensation than a second class insurance or dry goods clerk, while the collector of a port, with but little to do personally, except

to "set up the pins" for his party, enjoys an income of ten times as much.

So, likewise in the states, salaries are often a very inadequate compensation for the service required. So recently as five years ago, the constitutional salary of the governor of Wisconsin was twelve hundred and fifty dollars; and it is not long since the salary of the chief justice of the state was but twenty-five hundred dollars, while certain officers of the county government were receiving twice as much for services of a much lower grade.

It is not a sufficient answer to the objection, that a given salary is not a sufficient compensation for the duties of the office to say, as is usually said, "There are a plenty of competent men willing to accept of the salary and perform the service;" for, as a rule, it is not true. Competent men, in the fullest sense, willing to perform any sort of service for less than a fair living price, are not plenty. You may find here and there one who will make the sacrifice for a short time, for the purpose of accomplishing some worthy public object, or for the gratification of a private taste, or from the hope that the loss may be made up to him by some future advantage—motives, of which the public should be too just and honorable to take advantage. But such places are always liable to be filled by ambitious persons not competent, or who, being intellectually so, merely seek them for the illegitimate profits it is supposed they may be made to yield.

To state the whole case in the fewest words, in determining the salary to be attached to any office, the question should be, not, For how small a sum is it possible to have the work done? but rather, What would be an adequate and liberal compensation for the quality of service demanded? For the fixing a compensation less than reasonable must have the effect to discourage competent and honorable men from accepting public office, and hence to open the door to incompetency and fraud, greatly to the injury of the public service and the demoralization of the community.

For similar reasons, the method of providing compensation in the form of fees, moieties and the like, is injudicious, unjust to those who bear the burdens of the government, and demoralizing in its influence.

VI. A sixth and very important requisite is a change in the method of electing persons to office, so as to diminish the power of the *caucus* and guarantee the true *sovereignty of the people.*

It is manifest that he who owes his position, not to the people who are theoretically his constituents, but to a small clique of political wire-pullers, who have their own ends to accomplish, is in danger of holding himself, consciously or unconsciously, amenable to them, first of all, and of neglecting his duty to the people in the same proportion. The clique elected him once, and they can do it again. Why then trouble himself too much about the will of the multitude, who can practically neither help nor hinder?

As this is not a pure democracy, and cannot be, the system of representation is unavoidable and must be used alike in the making and in the execution of the laws. The question is, therefore, not, how to do away with representation, but, how to limit it and rid it of objectionable features, so as to give practical effect to every individual elector's ballot, and, as a consequence, to make every representative, in whatever capacity, directly responsible to his constituents. Every intelligent citizen must see, on reflection, the vital importance of this object, if we would save our republican system of government from passing irrecoverably into a practical and intolerable oligarchy of the majority, nay worse than this, a tyrannical and ruinous oligarchy of the caucus.

This object can only be accomplished by the adoption of *some system of personal representation*, to the maturing and introduction of which the attention of thoughtful and patriotic citizens throughout the country should be directed. A system

so planned that it would secure the elector from the present necessity to support one of two candidates, dictated to him by a clique of political managers, or to throw his vote away, and give to him a free choice of candidates from the whole body of his fellow citizens; that would give to every ballot a definite and an equal political value; that would give to each constituency its due proportion of political power; that would insure to each class of citizens and each public interest their just share of representation in the government; such a system would certainly guarantee a great improvement in the quality of the civil service, in the manner already pointed out—by increasing the conscious weight of every official's responsibility to those who gave him their suffrages. It would accomplish still more, in an indirect way, by putting an end to the trickery and tyranny of the nominating caucus and convention; by insuring in many instances the election of a class of superior men, who under present conditions are neither able nor willing to take part in politics; by diminishing the temptations to bribery and other forms of corruption in elections; by increasing the elector's sense of the responsibility of citizenship, and stimulating him to the acquirement and exercise of an intelligent judgment in governmental affairs; and, finally, in general terms, by improving the intellectual standard and elevating the moral tone of the whole body of the people.

VII. Still another requisite is the infliction of the most summary and condign punishment upon all who are found guilty of corruption in securing, or of malfeasance in, office.

It is not enough to provide every safeguard against the appointment and election of bad men to office. In spite of all that can be done to prevent it, there will be cases in which men will work themselves into power by dishonest means; in which, likewise, persons fairly entitled will prove traitors to the public interests they were chosen to protect. The purchase of place by ambitious charlatans and unscrupulous dem-

agogues; the bartering of legislative power and privilege, for influence or pecuniary gain; the corrupt letting of contracts; embezzlement of public funds, and rascality in many other forms, have their root in human nature and are incidental to all governments. But they would certainly occur less often, even under the best possible system, if their perpetrators when detected, were made to feel the full rigor of the law and the withering condemnation of the people.

VIII. But it were unphilosophical to expect official virtue to outmeasure public virtue. It is only in exceptional cases that a representative of the intelligence of a community will not also be a fair representative of its morality. Hence it is requisite, above all, that the community, the state, and the nation should adopt and vigorously enforce measures calculated to increase the intelligence and to strengthen and refine the moral sense of the people.

This is a trite statement. But that it sadly fails of universal recognition, even among those who rank as intelligent leaders and guides in social and political affairs, will appear from the action of great numbers of town boards, municipal councils, and legislative assemblies.

We are a great nation, aiming at self government — the only great republic so fortunate in its conditions of social and political life as to have gained the world's confidence. Confident of the ability of the republican system, under these favorable conditions, to successfully resist the disturbing or deteriorating influences consequent on the immigration of the multitudes destined to come, first from the oppressed populations of Europe, and later from the semi-barbarous lands of the Orient, the founders of the government made easy provision for their absorption into the body politic. Then, to make the system of government more fully consistent with the principle of equality, which lies at its very foundation, we have ourselves extended the privileges of citizenship to the millions of

our black population who were, but recently, in the chains of slavery, and are of necessity still in the fetters and clogs of the grossest ignorance. And soon, as a logical necessity, the same privileges and immunities that we enjoy will be accorded to the whole body of women. But with all this recent and prospective multiplication of voters unaccustomed to the responsibilities of freemen, it is only with the utmost difficulty, and after a struggle of many years, that the American congress has been induced to concede that the government owes anything further to the cause of popular education, after having granted for its encouragement a small portion of the unsold public lands. Even at this hour we present the spectacle of a mighty nation of forty millions resting our only rational hope of a great and glorious future on the intelligence of the masses, and yet showing a most alarming proportion of illiteracy, hesitating over the proposition to consecrate the net proceeds of the public lands, hereafter sold, to the education of the people, and denying to the cramped and crippled, though nobly officered, Educational Bureau of the Interior Department the few thousand dollars essential to its greater efficiency. In such schools as we have, but little instruction is given in the elementary principles of our government, and in too many of even the best of them there is recognized a much more important defect bearing upon the question of good government, namely, the want of a judicious and systematic culture of the moral nature, such as is calculated to insure to the country virtuous and noble men, in all respects fitted to meet the responibilities of citizenship, and to save the republic from the increasing dangers which already threaten its destruction.

To my mind, nothing is more manifest than that this requisite, although mentioned last, lies at the foundation of all. In a country governed by an autocracy or a monarchy, it is possible to have an efficient and economical civil service without universal intelligence, with intelligence of the governing

class merely. But in a republic, the way to whose highest places of power and trust is open to any citizen who has the intellectual energy or the mere self-assurance to enter, and who furthermore possesses the tact essential to political management, or only the means to command the tact of others, there is no security short of universal education.

Nor is this enough, if understood in the ordinary sense. The rudimentary education of the whole people is not sufficient. The elementary principles of government and of a sound social and political economy must also be widely understood and appreciated; and in every community the number must not be few of them who have made statesmanship a profound study.

Stopping short of the most ample provision for all these guaranties, we have left our free institutions in peril, and are justly obnoxious to the censure of mankind.

NATURAL HISTORY AS A BRANCH OF ELEMENTARY EDUCATION.

BY DR. P. R. HOY, RACINE.

I am persuaded that great good would result from making the study of natural history one of the most elementary branches of education. Children should be taught to see carefully and minutely, and thus early learn to observe and compare, a most important part of education. Their attention should be directed to the more common objects by which they are surrounded.

The chipping bird that pecks at crumbs in the yard, and nests in the currant bush, what a warm, light and beautiful feather-coat it wears, its wings are only a variety of hands which enable it to fly where we cannot follow. See how it hops, with one foot a little in advance of the other, in place of running, or walking like the chickens. All birds that perch on trees move by hops, when on the ground.

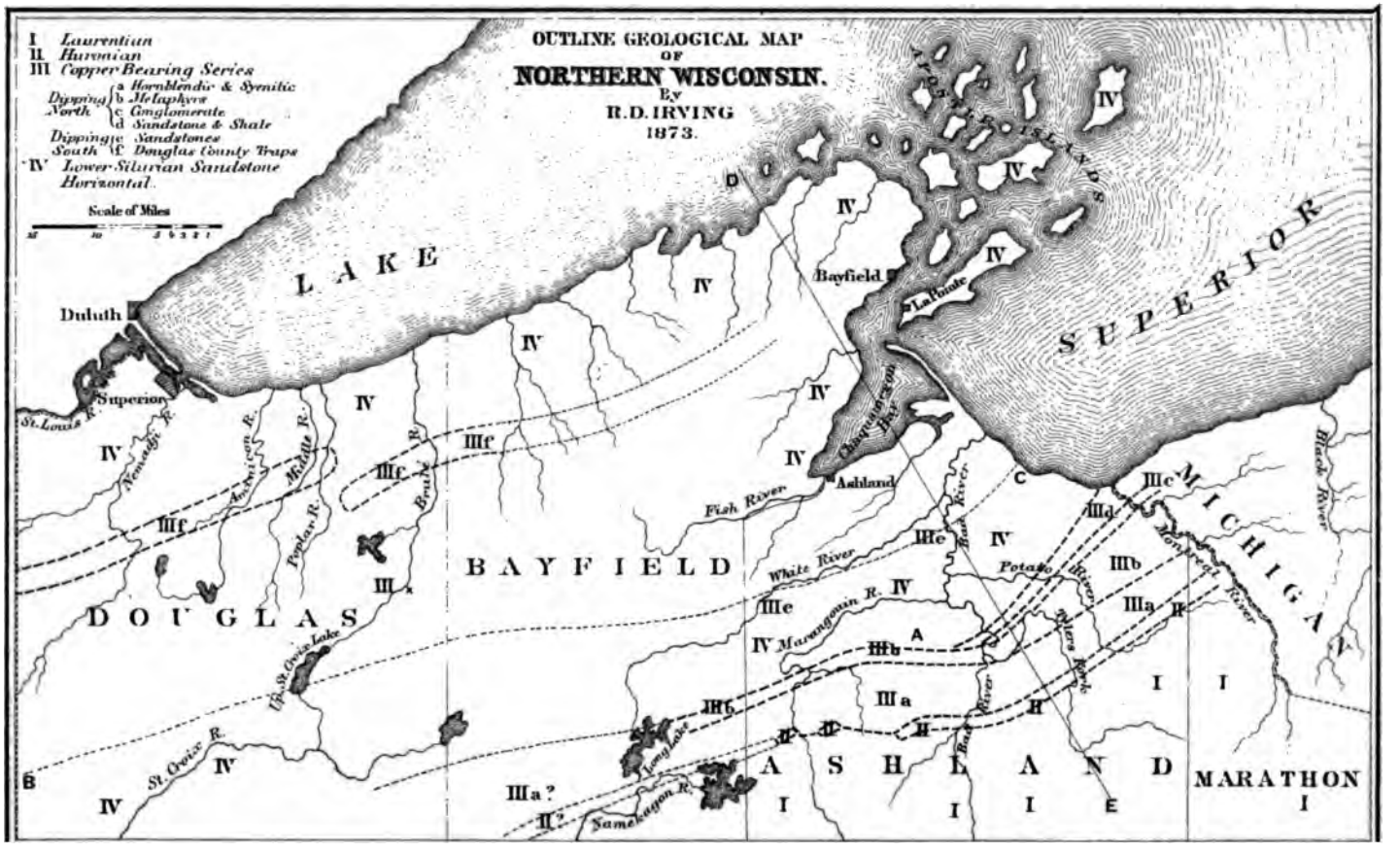
The ant that labors so diligently in the garden—observe its six feet, its pinchers to clip and cut its food, its antennæ, by means of which it makes its wants known to other ants. How busily they are running up and down that tree. Watch and we shall find that they have discovered the locality of their cows (plant lice), and are in haste to sip the sweet fluid secreted by these curious insects.

See the "pinch bug," that comes stumbling in at the open window, attracted by the light. Observe its antennae; how curious its eyes, how large. All beetles have a beautiful box fastened on their backs, in which are neatly packed their delicate, transparent wings They elevate the two lids (wing cases), and unfold the glacy wings, then they prepare to fly.

What curious claws, like forks, this fellow has to enable him to hold on securely. What stout jaws. You see they open sidewise, instead of up and down, like all the large animals. There too is the butterfly that flutters on the garden flowers, sucking with its long tongue, the sweets of the blossoms. It has no pincers; like the ant and bee it cannot bite. What large beautiful wings, four in number. See the long "feeler," with a nob on the end. The spider, that spreads its lace trap, to catch heedless flies, the grasshopper that springs up from the grass. All, these thing should be a subject of thought, observation, and comparison; for it is by *comparison* that we form ideas of the differences which exist between things; by comparison alone that we reach conclusions the most valuable for the developement of mind and the acquisition of knowledge.

How common the mistake parents and, I am sorry to say, teachers often make, in impressing the young and sensitive mind with horror and alarm, at the sight of the more harmless, and in all cases, beautiful works of God. Impressions thus made in youth, are very permanent and should be carefully avoided. We should be ever watchful that nothing prejudicial finds a lodgment in the minds of our children.

There is nothing farther from the truth, than that "any one is qualified to teach primary schools." It is far more difficult to teach the rudiments with profit than the more advanced branch of any subject. Especially is this true of Natural History. I am aware of the difficulty, the lack of qualified teachers; but let the demand be made with sufficient *emphasis* and the supply will be furnished. The law of demand and supply is as good in education as in commerce.


OUTLINE GEOLOGICAL MAP
OF
NORTHERN WISCONSIN.
By
R.D. IRVING
1873.
I Laurentian
II Huronian
III Copper Bearing Series
Dipping North
a Hornblendic & Syenitic
b Metaphyre
c Conglomerate
d Sandstone & Shale
Dipping South
e Sandstones
f Douglas County Traps
IV Lower Silurian Sandstone Horizontal.
Scale of Miles
LAKE SUPERIOR
Duluth
Superior
St. Louis R.
Nemadji R.
Amnicon R.
Middle R.
Poplar R.
Brule R.
Bayfield
La Pointe
Apostle Islands
Chequamegon Bay
Ashland
Fish River
White River
Marengomin R.
Potato River
Bad River
Montreal River
Black River
Flambeau River
Tyler Forks
Big St. Croix Lake
St. Croix R.
Long Lake
Sameksagon R.
DOUGLAS
BAYFIELD
ASHLAND
MARATHON
MICHIGAN
IV
IIIf
IIIe
IIIb
IIIa
IIIa ?
II
I
A
B
C
D
E

DEPARTMENT OF NATURAL SCIENCES.

ON SOME POINTS IN THE GEOLOGY OF NORTHERN WISCONSIN.

BY ROLAND IRVING, A. M. E. M.,
Assistant State Geologist of Wisconsin.

When the title of my paper was sent to the secretary, in answer to his request, I had intended to give in detail all the facts I could collect bearing on the question of the age of the copper bearing rocks of Lake Superior—the subject proposed in the title then sent—including also the observations made by myself and my assistants in northern Wisconsin; and to elaborate a subject which is briefly stated without theoretical discussion in my report on the geology of that region, now before the legislature. My double professional duties have however, rendered it impossible for me to do this at all satisfactorily, so that I have been obliged to give up presenting an exhaustive paper to the Academy. It has seemed to me, however, that the very interesting discoveries made by my party, bearing on the relations of the copper bearing series of rocks, and the Silurian sandstones of the west end of Lake Superior, should be presented to the Academy in some way. I had supposed also that the members of the geological corps would be expected to give some account of the results of their work,—I propose, then, to give briefly an outline of the geology of the district which has been under my charge, including a bare statement of the discoveries alluded to. This I am

the more able and willing to do since no special preparation is required, the subjects being those upon which my thoughts have constantly dwelt for many months past.

I. There are four distinct groups of rocks in northern Wisconsin, the *Laurentian* granites, gneiss, and schists; the *Huronian* schists, quartzites, iron ores and diorites; the melaphyrs, porphyries, greenstones, conglomerates, sandstones and shales of the series known now as the "copper bearing rocks;" and the lower silurian sandstones. In addition to these are enormous thicknesses of quarternary clays and of boulder drift.

The Laurentian (I on the map and section) rocks, are always furthest removed from the lake, never coming nearer to it than eighteen miles, and being usually much more distant than this.

So far as observed these Laurentian rocks are altogether granitic, gneissoid or syenitic in character, though undoubtedly various schistose beds must be present, since they are found just east of the eastern limit of the district, within the area of the upper peninsula of Michigan. In Wisconsin the rocks of this group are almost everywhere overlaid by enormous accumulations of drift material, showing through this covering in but very few places. This overlying drift is heaped up in masses which sometimes attain the altitude of from 1,100 to 1,200 feet above lake Superior. Amidst these drift heaps, and amidst the swamps which everywhere cover the country between them, the northward and southward flowing streams interlock in an intricate manner, the former in a distance often not more than thirty miles from their sources to their mouths, falling as much as 700 or 800 feet. It can readily be seen from this that their courses must be a series of chutes and falls, which is the fact, the single falls reaching in many instances a height of from 60 to 70 feet, and in one instance at least, that of Black river in Douglas county, a height of 160 feet.

The completeness with which this drift covering conceals the Laurentian rocks, may be understood, when I say that in all that portion of Ashland county underlaid by them, an area of not less than 800 square miles, only four localities are known where outcrops are to be seen, all of which are very near to the junction of the overlying Huronian, and two of which are caused by the action of rivers, the main Bad river and its Marangouin branch,—where they leave finally the Laurentian rocks and pass on to the Huronian. At each of these places the exposures are bold, and give rise to falls of some size. Those on the Marangouin have a height of sixty feet in three leaps, the river curving as it falls, so that the last leap faces in a direction at right angles to the first, the curve being around a bold face of syenitic rock.

The *Huronian* (II on map and section) rocks, which directly overlie the Laurentian and *unconformably*,—as shown by Brooks and Pumpelly, from observations made by them just east of the Montreal river in Michigan—constitute in Ashland county a continuous narrow belt, whose central portion is the well known Penokie Range, and whose width never exceeds two miles, being generally much less than this. These rocks extend without break into Michigan, almost as far as lake Gogebic, when they become lost, being covered by accumulations of drift, and finally by newer rocks, until, one hundred miles east of lake Gogebic, the Marquette Iron Region is reached, where they are again found, but covering a much wider extent of country than in Wisconsin. Towards the west, the Huronian belt comes to an abrupt ending, the underlying Laurentian, and overlying Copper Bearing series closing in on one another. Still further west, however, just on the west side of Ashland county, are two isolated belts of Huronian rocks, in every way similar to the main area, having each also its central ridge rising abruptly above the level of the country. Further west still, we know nothing of its continuance. In an old congressional document I find an

account of a trip made from the interior of Wisconsin to Lake Superior, by way of Long Lake and White river, by Dr. Randall, one of the assistants under Dr. D. D. Owen, then in charge of the geological survey of Wisconsin, Iowa and Minnesota. He gives a detailed description of all the rocks seen, but says nothing of any that could possibly be Huronian. I infer their absence, or entire concealment by drift material.

This question of a western continuation of the iron belt of Penokie range opens an interesting field for further investigation the question being one of economic importance, quite as much as of scientific interest. We have absolutely no *facts* going to show the entire absence of the Huronian in the southern ends of Bayfield and Douglas counties. The wonderful quantities of iron which the strata of this series carry everywhere on the south shore of Lake Superior, makes this investigation of such importance that it should be undertaken at an early day by the geological survey. The dip needle will soon tell the story, even if the rocks are entirely concealed by drift.

The rocks of the Huronian group in northern Wisconsin are siliceous schists, talco-siliceous schists, white quartz rock, very peculiar black slates of unknown lithological affinities, magnetic and specular schists and slates, banded magnetic schists (alternating bands of magnetite and jasper or quartz), metamorphic diorites, and diorite schists. In Ashland county the whole series divides naturally into three portions. The *southernmost, lowest or oldest* portion is composed mostly of simple siliceous schists with some granular white quartz, grey quartzite and black slate. The *central portion*, consists of magnetic and specular slates and schists, whose content of the oxyds of iron varies from a fraction of one per cent. to sixty and even eighty per cent., in which latter case the schists are iron ores. In this portion of the group occur all the famous ores of the Penokie Range—and indeed *all* the ores whose existence is yet known—these ores being never intercalated lenticular masses, independent of the enclosing rocks, but simply portions of the

great group—five hundred feet thick—of magnetic and specular schists, carrying a larger portion of the oxyds than the general run. *The northernmost, highest, or newest portion of the group*, consists, so far as known, almost entirely of diorites, diorite slates and diorite schists, one locality, however, of quartz slate is known, and no doubt more occurs, since this portion of the group is much concealed by drift, and, indeed, has not been examined with the thoroughness devoted to the lower members. Between the exposures of this uppermost member and the next one beneath, there is always a gap without exposures, at least a thousand feet in width, on the southern side of which rises the Penokie Ridge, whose mass is chiefly made up, at least on its western portion, of the middle member of the group. It is evident that some general cause gives rise to the lack of exposures in this interval, which cause I take to be greater softness of material; and, inasmuch as in the Huronian of the Marquette region, the soft portions are chiefly the soft hematites, which are never found outcropping, for this reason, and for others, I have recommended in my report, that this part of the county be thoroughly searched by test-pitting.

The total thickness of the Huronian series at Penokie Gap, as calculated from actual measurement, is about 4,000 feet, as follows:

		Feet.
Lowest member	not exp.,	900
	in sight,	700
Central member		600
Space without exposure		1400
Upper member		400
		4000

About fifty miles east of Penokie Gap, Messrs. Pumpelly and Brooks estimate the thickness of the same belt at 4,000 feet, a remarkable uniformity of its structure is thus shown.

Copper Bearing Series.—Next north of, and immediately overlying the Huronian, are the enormously thick beds of the copper-bearing series, which have, in all, an apparent thick-

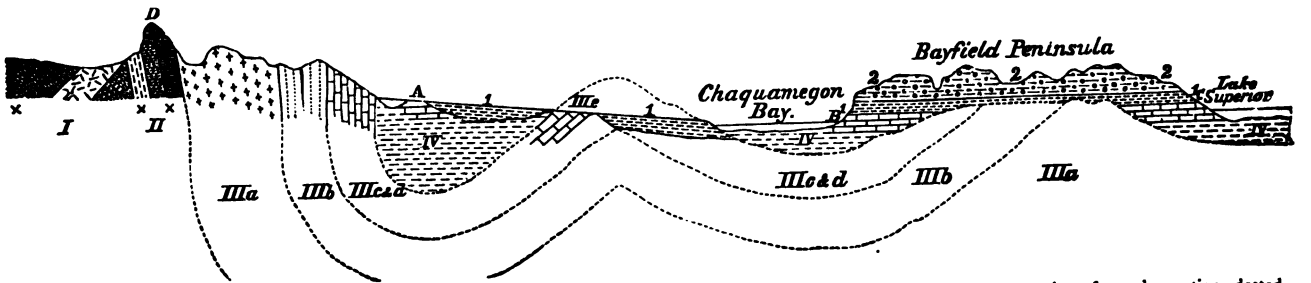
ness never less than four miles, and in places on the east much more than this. This enormous thickness may be due to some extent to folding and faulting, although no evidences of this have been seen. Of course, if portions of the group are of igneous origin, as they are supposed to be, the great thickness may be readily explained by the rapid formation of molten masses. Still, the upper portions of this series are, beyond all doubt, the results of sedimentation exclusively, and in one portion of Ashland county, one can walk over the edges of upturned sandstones, which show no sign of fault or fold whose actual thickness, after making the trigonometrical correction for dip, falls but little short of 10,000 feet.

The rocks of this copper-bearing series, form in Ashland county a broad belt, which is widest at its eastern end, where the rocks reach the shore of the lake, and narrows toward the west, at the same time receding toward the southward. The most westerly known portion of this belt is at Long Lake, in the southern end of Bayfield county. East of the Montreal river the series continues without break to the end of Keweenau Point. The Wisconsin belt, however, is the result of the fusion of two distinct belts in Michigan, which come together just east of the Montreal river, and which, eastward of the point of junction, are separated by an area underlaid by horizontal Silurian sandstones.

Northward of the belt of copper-bearing rocks in Ashland county, and removed from it as much as eight or ten miles, are two or three isolated outcrops of sandstones and traps, along a line some twenty-five or thirty miles in length, which I have regarded as forming the northeasterly edge of a synclinal of which those already mentioned, to the southward, form the southerly edge.

In Douglas county, the Copper Bearing Series is largely represented, and forms a broad belt curving southwestward across the county from one side to the other, and extending on the east into Bayfield county, whose peninsular form is doubtless due to this continuance, as indicated further on.

SECTION ALONG LINE D E OF MAP.



1. Red Marly Clay. 2. Boulder Drift. A, Penokie Iron Range. B, C, G, Horizontal Lower Silurian Sand Stone. Full line portions from observation, dotted line ideal. For further explanation see Map.

The Copper Bearing Series in Ashland county divides naturally into three members.

The lowermost member, designated A, in my report [II. a], covers the broadest surface of country of any of the three divisions. The rocks are always highly crystalline, generally very coarsely so, and present such a variation in lithological characters that I have not yet attempted to describe all the varieties, or even a small portion of them. The prevailing kinds, which themselves, however, include many varieties, are: 1st, a dark colored, coarsely crystalline rock, breaking with jagged edges, and showing broad, crystalline faces, with often a high lustre, varying in color from a light gray, through green, to dead black, and composed apparently of either hornblende or pyroxene, and a triclinic feldspar, probably in most cases Labradorite, although this last ingredient does not seem always to be present; that portion of Ashland county just north of English and Bladder lakes, presents on all outcrops, which are very numerous indeed, rock of this character: 2d, peculiar varieties whose aspect is usually pinkish, from the presence of orthoclase feldspar, and a black mineral probably, hornblende, with a varying amount of quartz: 3d, finer grained hornblendic and pyroxenic rocks.

The indications of stratification in this portion of the group are seldom seen—the whole mass being apparently without it—still, in the few places where they are seen, they are marked, and point towards entire conformability with the underlying Huronian.

Next north of and overlying the rocks just described, are the beds of that portion of the group designated B in my report [III.b.] This division, like the preceding, occupies a belt of country stretching entirely across the county, and having a much greater width on the eastern side. It includes a series of alternating beds of trap of many different kinds, both amygdaloidal and compact, always cryptocrystalline, and, in the upper portions, beds of a very remarkable conglomerate, (III.c.)

together with great thicknesses of sandstone (III.d.) and shale. These sandstone, shale and conglomerate beds do not altogether overlie the trappean beds, *but are, near the junction, directly and unmistakeably interstratified with them.* The whole series, traps, conglomerates, shales and sandstones, have a very high dip to the north, seldom less than 85 degrees, the beds having often a true vertical position. The sandstone, conglomerates and shales have not as yet been seen west of Bad river, in the central part of Ashland county, but the trappean members can be traced uninterruptedly as far west as Long Lake.

The outcrops of traps and southward dipping sandstones (III. e), already alluded to, I have regarded as being really the same as those just described, forming the opposite edge of a synclinal.* These rocks are exposed only in isolated patches, those thus far seen in Ashland county, being sandstones only, of great thickness; but on the same line further west, in Bayfield county, trap occurs.

Silurian.—Over all that portion of Ashland county north of division "B" of the copper bearing series, there is an immensely thick mass of a peculiar red marly clay, almost every where concealing the underlying rocks, which are exposed in but very few places. In the interval between "B" and the line of southward dipping sandstones, are found horizontal sandstones and shales in every way similar to those on the Apostle Islands, which last constitute the fourth great group of northern Wisconsin. These sandstones are, without doubt either the exact equivalents—or, which is more probable the downward continuation—of the light-colored primordial sandstones of the Mississippi valley. They form every where the basement rock of the Apostle Islands, and of the adjoining coast of Bayfield county. Following them westward into Douglas county they can be traced, with the same horizontality, to exact junction with the copper bearing traps of that part of the state, (III.f.) Farther south,

*See section.

again, these sandstones reappear (at points marked IV), on the head waters of the St. Croix, from where they can be traced uninteruptedly until they disappear beneath the light-colored sandstones of the Mississippi valley. From these latter the horizontal red sandstones of the west end of lake Superior differ much in appearance and composition, being always of a dark red or reddish brown color, and always carrying a large percentage of sesquioxide of iron, and of alumina. These peculiarities have led many geologists to assign these red sandstones to a much later date than the Lower Silurian, and it has always been wondered why they should so differ from the light-colored sandstones of the Mississippi, if they are of the same age. The explanation is, however, very simple, as shown further on.

On the east side of Keweenau Point there are horizontal reddish sandstones which are, without doubt, the exact equivalents of those just described, because: 1st. they bear the same relation to the associated copper bearing and Huronian rocks; 2d. They graduate upward into light-colored sandstones, which themselves pass underneath limestones of Trenton age; and, 3d. They extend westward nearly as far as the Montreal river, being thus separated from the sandstones of the west end of the lake by only a few miles.

Having given thus briefly an outline sketch of the geology of northern Wisconsin, with the main features of its four great groups of rocks, it remains for me to draw your attention especially to those points bearing on the age of the copper-bearing series. The age of this series, as well as that of the accompanying horizontal sandstones, now proved to be Lower Silurian, has for years given rise to discussion, the earlier geologists calling them all Triassic, Foster and Whitney making them the equivalents of the Potsdam sandstones of New York, whilst the Canada geologists have regarded them as the equivalents of the Quebec group of Canada East. Still more lately Mr. Bell of the Canada Geological Survey, has revived the

half forgotten theory of their Triassic age. All of these geologists have however considered these two groups, i. e., the copper-bearing, and the horizontal sandstones as of the same class. It is only within the last year that Messrs. Pumpelly and Brooks have recorded observations, going to show an entire difference in age between the two groups, and proving that the former is much the older of the two.[1]

[2] In Michigan the highly tilted beds of the Copper Bearing series, which dip northward, and which form the back bone of Keweenaw Point, are flanked on the south and east by horizontal Silurian sandstones, which abut directly against their upturned edges. These sandstones continue westward nearly to the Montreal river, having the tilted beds of trap always on the north. They come to an end where the belt of Copper Bearing rocks on their north unites with one on the south. This more southerly belt is composed like the northern one of a series of traps with interstratified sandstones and conglomerates, all inclined at a very high angle. *The horizontal undisturbed beds of the Silurian sandstones, occupies then a trough between two lines af highly tilted beds of the Copper Bearing series.*

In Ashland county, on Silver creek, *occur horizontal sandstone, and shaly sandstone, within a few hundred feet of Copper Bearing Trap, and within two miles of vertical sandstones of the same group.*

In Douglas county the horizontal sandstones are traceable to within a short distance of the trap—and sometimes to actual contact, the traps here dipping, wherever dip is observable always to the southward, and having no tilted sandstones and conglomerates associated with them.

The interstratification of the trap with sandstones, and their mutual conformability—as observable everywhere on the south shore of Lake Superior—proves that the trappean beds, if ever thrown out in a molten condition, must have been

[1] Am. Jor. Sci. June, 1872. T. B. Brooks—"Iron Bearing Rocks." Michigan geological survey, 1873.

[2] Brooks and Pumpelly.

spread out in horizontal layers on the bottom of the sea, whilst the sedimentation of the sandstones was still in progress. Hence the present tilted position of these sandstones and traps was produced by a movement entirely subsequent to the solidification of the latter; *and, therefore, the tilted position of the sandstones of the Montreal and Bad rivers, those of the former reaching a thickness of nearly ten thousand feet, is not due to the protrusion of igneous rock, but to an ordinary regional dislocation, in which the trappean beds themselves partook. Moreover the strong indications of conformability between the whole of the copper bearing series, and underlying Huronian, goes to show that this disturbance was due in part, at least, to the same causes that elevated and folded the beds of the latter series.* We have then in this case horizontal sandstones found in immediate proximity to sandstones which have undergone regional disturbance. *The vertical sandstones, then, belong to a period far antecedent to that of the horizontal sandstone.*

The conclusions, then, that I would draw are these:

1. The Copper Bearing and Huronian Series were once spread out horizontally one over the other and owe their present highly tilted position to one and the same disturbance.

2. That subsequently—after a long period of erosion—the horizontal Silurian sandstones were laid down over, and against the upturned edges of the Copper Bearing Series, filling also the synclinal, in Ashland county, which lies between the northward and southward dipping sandstones.

3. That hence the Copper Bearing Series is more nearly allied to the Archaean, than to the Silurian rocks.

One fact observed, however, seems at first difficult of explanation on this hypothesis. In Douglas county, as already said, the horizontal sandstones can be traced to their exact junction with the southward-dipping traps. But, in several places, these sandstones present a very remarkable change as the trap is approached. On passing up the gorge of Black River, whose sides are perpendicular exposures of rock over one hundred

and fifty feet in height, towards the south, the horizontal layers of sandstone are suddenly seen to change from their ordinary position to a confused mass of broken layers, dipping in every conceivable direction, and increasing in confusion as the trap is approached, until, finally, the whole changes to a confused breccia of mingled trap and sandstone fragments. This appearance is presented along both sides of the gorge, for a distance of 300 feet, and I am assured by my assistant, Mr. E. T. Sweet, by whom all observations in Douglas county were made, that it is certainly due to no mere surface displacement. The same appearance is presented on one of the other northward flowing streams in Douglas county, on a much diminished scale however, the undisturbed sandstones reaching within twenty feet of the trap. On all other of these streams, the sandstones are undisturbed. The explanation which first suggests itself to account for these disturbances is naturally, that they were caused by the ejection of the traps through the already formed sandstones. In answer to this it may be said that it is very difficult to see how just such a disturbance as this could have been caused in this way, the sandstones presenting no appearance of baking or other indication of heat, but seeming rather to have been *crushed* by a pressure from the south. Next the trap it is crushed to a confused mass, a little further a few layers of sandstone become distinguishable, still further these are all distinct but broken and pitching in every direction, and finally they grade into regular unbroken horizontal layers. It may also be said that the proofs already given of the greater age of the copper bearing rocks, as compared with the horizontal sandstones are so strong as to necessitate some explanation of these disturbances other than the one just mentioned. The only one that I can offer, is this; the traps being deep seated are, as it were, independent of the more superficial sandstones, and would, if impelled to move by any force, move independently of them. Now a very slight movement of the traps northward against the sandstones would

produce all the phenomena observed. Such a movement is not at all difficult to explain.

II. *Westward continuation of the Lake Superior synclinal.*

Foster and Whitney long since pointed out that the rocks of Isle Royale and those of Keweenaw Point formed the opposite edges of a synclinal in whose depression lie the waters of Lake Superior. The rocks of Keweenaw Point continue westward uninterruptedly as far as Long Lake in Wisconsin. Do those of Isle Royale extend westward in a similar manner? I have obtained facts going to show that they do, and that the peninsula of Bayfield owes its existence to this extension. The facts alluded to are these: 1st. The known existence of a synclinal in Ashland county. 2d. The southward dip of traps of Douglas county. 3d. The known existence of an extension of the Douglas county traps into Bayfield county.* 4th. The vertical position of the beds of traps and sandstone in the westward continuation of the Keweenaw Point belt, as compared with the much lower dip at its eastern end;—since towards the west the two sides of the supposed synclinal approach more nearly to one another, it would be expected that the dip would be much greater, on one side at least, than where they are far apart. 5th. A westward continuation of the Isle Royale rocks is nowhere else found. 6th. The Douglas county traps are very similar to those of Isle Royale. The accompanying section shows at once what is actually known of the geology of the country along its line (D. E. on accompanying maps), and the probable structure of the concealed portions.

The views thus set forth at once explain, and are confirmed by, the ferruginous and aluminous character of the Lower silurian sandstones of Lake Superior, as compared with the quartzose character of their equivalents in the Mississippi valley; *the former have been derived from the wear of the feldspathic and magnetite bearing traps of the Copper-bearing series, whilst the latter owe their material to the wear of quartzose Laurentian granites and of Huronean quartzites and schists.*

*These traps disappear under the drift as they are traced eastward.

SOME OF THE PECULARITIES OF THE FAUNA NEAR RACINE.

BY P. R. HOY, M. D., RACINE.

With few exceptions, the facts recorded in this paper were obtained by personal observation within fifteen miles of Racine, Wisconsin, lat 42° 49′ north; Long. 87° 40′ west. This city is situated on the western shore of Lake Michigan, at the extreme southern point of the heavy-timbered district the base of which rests on Lake Superior. At this point the great prairies approach near the lake from the west.

The mercury rises in summer from 90 to 100° Fah., while in winter it sinks from 12° to 20°. The average daily temperature for the four warm months, June, July August and September, is within a fraction of 70° Fah.

The isothermal line curves farther north in summer and retires farther south in winter, than it does east of the great lakes; which physical conditions will sufficiently explain the remarkable peculiarities of its animal life the overlapping, as it were, of two distinct fauna. More especially is this true of birds, which are enabled to change their locality with the greatest facility.

Of summer birds I will enumerate only a few of the many that belong to a more southern latitude in the Atlantic states:

Yellow-breasted Chat, *Icteria Virideis.*
Mocking Bird, *Mimus Polyglottus.*
Great Carolina Wren, *Thriothorus Virginicus.*
Summer Redbird, *Pyrangia Æstiva.*
Carolina Parrot, *Conurus Carolinensis.*
Whooping Crane, *Grus Americana.*
Wood Ibis, *Tantalus Loculator.*
Royal Tern, etc., *Sterna Regia.*

Among Arctic birds that visit us in winter are:

The Great Grey Owl, *Syrnum Cinereum.*
Hawk Owl, *Surnia Ulula.*
Arctic Three-toed Woodpecker, *Picoides Arcticus.*
Banded Three-toed Woodpecker, *Picoides Hirsutus.*
Magpie, *Pica Hudsonica.*
Canada Jay, *Perisoreus Canadenses.*
Evening Grosbeak, *Hesperiphona Vespertinus.*
King Eder, *Somateria Spectabilis.*
Black Throated Diver, *Colymbus Arcticus.*
Glaucus Gull, *Laurus Glaucus.*

Of mammals I will instance:

The Opossum, *Didelphys Virginica.*
Silvery Mole, *Scolaps Argentatus.*

As belonging farther south.

Of northern mammals found here are:

Pine Marten, *Mustela Americana.*
Canada Lynx, *Lynx Canadensis.*

Reptiles, southern forms:

Glass Snake, *Ophisaurus Ventralis.*
Blue Tailed Lizard, *Sincus Faciata*; (as far north as Lake Winnebago.

Insects furnish many interesting examples of Southern species found here, some of which are abundant, as: *Leucanus elephas, Copris Carolina,* (*Phanaeun*) *carnifex, Terias nicippe, Colydryas ebula, Paphia glycerium, apatura Celtis*, etc., etc.

These examples are sufficient to indicate the rich fauna of this locality. It is doubtful if there is another locality where the *Canada Jay* and its associates visit in winter, where the *Mocking Bird* nests in summer, or where the *Hawk Owl* flits silently over the spot occupied during the warmer days by the

Summer Red-bird and the *Yellow-breasted Chat.* Within the last twenty-five years in the narrow bounds of Racine county there have been collected over *three hundred* species of birds; more than have as yet been noticed in any single state—nearly one half of all birds known to naturalists within the entire territory belonging to the United States.

But the axe has already leveled much of the "great woods," so that there is now a great falling off on the part of our old familiar feathered friends. It is extremely doubtful if such a collection can ever again be made within the limits of the state.

ON THE RELATION OF THE SANDSTONE, CONGLOMERATES AND LIMESTONE OF THE BARABOO VALLEY TO EACH OTHER AND TO THE AZOIC QUARTZITES.

BY JAMES H. EATON, PH. D.

Professor of Chemistry and Mineralogy, Beloit College.

The age of the quartzite hills and ridges of Sauk county has been satisfactorily determined by Mr. Roland Irving[1] to be pre-silurian. Mr. James Hall[2] in his report of the State Survey, calls them Huronian. Their relation to the great central area of azoic rocks in Wisconsin may, perhaps, be determined by finding their junction with the latter. On Dr. Lapham's map a small region on the Eau Claire river, adjacent to the great central area of granitic rocks, is colored as quartzite. An examination of this locality, to determine whether the quartzite rests unconformably upon the granite rocks, would doubtless determine their age.

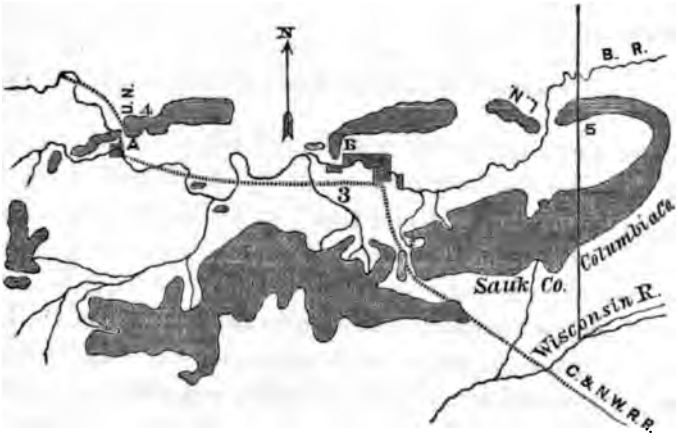
The accompanying map is by Mr. Wm. H. Canfield, of Baraboo, who for many years has been the official surveyor of Sauk county. It is taken from surveys made by him with the especial purpose of marking the quartzite outcrop.

In regard to it I would only remark, that it does not present so much the appearance of two parallel ridges, terms generally used in describing the elevations on either side of the Baraboo river, as of a group of islands, with a common east and west trend at right angles to the dip of the rocks. These elevations formed islands in the Potsdam sea. The point marked (2) on the map is the locality from which the fossils were obtained,

[1] Trans. of the Wis. Acad'y, 1871-72, p. 129.

[2] Survey of Wis., p. 11.

which were described by Mr. Alexander Winchell* in 1864. I was assured that there is a quarry of the rock in place near by, but a subsequent visit has shown that the sandstone only exists at this point as loose pieces. In a short time a larger number of Potsdam fossils were obtained. They were *Scolithus Linearis*, Hall, *Orthis Baraboensis*, Winchell, *Straparollus primordialis*, Winchell, *Dicellocephalus Minnesotensis*,



A, Abelman; B, Baraboo; B R, Baraboo River; L N, Lower Narrows; U N, Upper Narrows. 1, Devil's Lake; 2, 3, Potsdam Sandstone; 4, Section; 5, Limestone. Scale, three-twentieths of an inch equal to a mile.

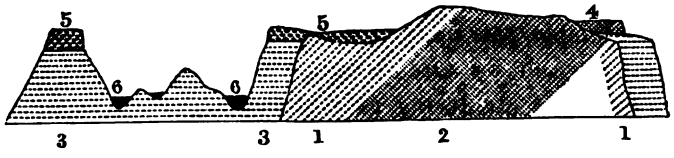
Owen. At the locality marked (4), however, is a section (fig. 2), which is truly magnificent in its exposure of all the rocks, which belong to this region, in their stratigraphical relations, except the limestone. It is at the railroad station, Abelman. The Baraboo river, in forming the upper narrows, has left upon the east side a nearly vertical section, about half a mile long and 300 feet high at the highest point. This section is of a core of tilted rock, flanked on *both* sides by horizontal Potsdam sandstone and conglomerates. No doubt can therefore remain that the tilted rock is Pre-silurian.

The dip of the entire section of Azoic rock is to the north or slightly west of north. Its face is cut by numerous vertical

*Am. Jour. Sci. and Art, II, vol. XXXVII, p. 296.

joints in the same manner as the cliffs at Devil's lake. At the extreme southern end, the rock varies from a compact, dark-colored, homogenous quartzite to a much less compact and lighter quartzite. One large detached block of the hard, dark quartzite was seen beautifully covered with ripple-marks. Passing along the face of the cliff toward the north, it becomes covered with large blocks of quartzite, sandstone and conglomerate, which have fallen from above. Coming to the exposed rock again, it changes to a metamorphic conglomerate. This makes up more than half the section. It consists of *angular* pieces of the compact, dark quartzite, firmly imbedded in a cement of white crystalline quartz. The former vary in size from small fragments to masses several tons in weight. Numerous cavities are lined with quartz crystals. The dip here is from 75–80° N.

Fig. 2.



1, Quartzite. 2, Metamorphic Conglomerate. 3, Potsdam Sandstone. 4, 5, Conglomerates. 6, Drift.

The remainder of the section consists of the homogeneous, dark, compact quartzite, bedded in the same manner. We have indications then of these successive sets of circumstances in Azoic times; those in which were formed respectively the underlying quartzite, the conglomerate and the overlying quartzite. The lower quartzite must have been already hardened from the moving sands before it was broken into fragments for its conglomerate. And then its cement was crystallized. Finally layers of sand spread over this were hardened. As has been said, upon the southern flank of this Azoic core, horizontal beds of Potsdam sandstone lie unconformably. They extend a short distance over the edges of the upturned beds of quartzite. The relations of this sandstone to the underly-

ing quartzite show most unmistakably the effects of shore action. The quartzite is generally in place, but the large blocks, formed by the crossing of the planes of bedding and the joints, are somewhat isolated, as if they had formed crags on an old coast, where the wearing of the waves had enlarged the cracks. Into these fissures and crevices the sand is forced. There are also blocks of quartzite, that have been displaced somewhat, which are enveloped in sandstone. In the sandstone itself is an occasional rounded pebble of quartzite. The sandstone which rests upon the northern flank is irregularly bedded, having the ebb and flow structure. Further north are these isolated hills of sandstone.

Resting on the sandstone at the south, and stretching also over the quartzite, is a conglomerate made up of a friable sandstone, like that below, containing numerous rounded pebbles of the quartzite of obvious sizes. The cement makes up a considerable part of the rock. This coglomerate, as I have assured myself by careful examination, is exactly like that mentioned by Mr. Irving, as occurring on the quartzite just northeast of Devil's Lake, and containing Potsdam fossils. The finding of this conglomerate, therefore, in its true relation, verifies Mr. Irving's supposition in opposition to Mr. Winchell, that neither the conglomerate nor the quartzite is the *base* of the Potsdam system, for here the true base comes in between, as sandstone.

In the same manner there is a conglomerate at the north, resting conformably on the sandstone and unconformably on the quartzite. One of the isolated hills of sandstone is also capped by the same. Though on the same level as the conglomerate at the south, its character is different. It is made up almost entirely of small rounded pebbles of quartzite of a pretty uniform size. The cement is quite hard, but true sandstone.

This section, then, represents an old Azoic reef of tilted rock, running east and west, washed upon either side by the

waves of the Potsdam sea. On the south the action appears to have been gentler than on the north, for the quartzite has been triturated to a fine sand, containing, to be sure, larger or smaller pieces of quartzite well rounded. The northern shore must have been exposed to the breakers, which washed out the fine sand and left pebbles of a uniform size. It may be that within the circle of these islands was a sheltered bay.

At the point marked (5) on the map is a limestone quarry. The limestone is horizontally bedded and rests on the southern flank of one of the ridges, but all points of junction with the underlying rock are concealed. About half a mile distant is sandstone on the same level, and in another direction is sandstone at least 100 feet higher. I am inclined to regard this limestone as a local deposit of the Potsdam epoch rather than of the Lower Magnesian epoch. The latter supposition would require an enormous erosion between the putting down of the Potsdam sandstone and the Lower Magnesian limestone. The fossils, also, a number of which were secured, although undetermined, have more the aspect of Potsdam fossils than of those of the following epoch. A number of cephalic shields of a trilobite, with other fossils, were obtained.

Another feature of interest in this region is the evidence of glacial action aside from the drift. At the point (3) on the map is an isolated hill of sandstone. On my visit the earth had just been removed from a large surface in order to quarry the rock. It was entirely smoothed and covered with glacial striae. Their direction is N. 66° E. On the surface of the limestone previously mentioned, the polishing is even more perfect, and the striae have the same direction. Polished surfaces have also been observed three quarters of the way up the quartzite hills. The most reasonable explanation of the deflection of the striae from the usual direction seems to be, that they were produced by ice masses small enough to be influenced in their motion by the east and west trend of the ridges.

NOTE ON THE RAPIDITY OF THE ABSORPTION OF ARSENIC BY THE HUMAN LIVER.

BY W. W. DANIELLS, M. S.,

Professor of Analytic Chemistry, University of Wisconsin.

In June, 1873, August Mansard died suddenly. In December following the body was exhumed, the stomach, bowels, and a portion of the liver were brought to me to be examined for poisons. The stomach and duodenum were examined at once, and found to contain eight grains of arsenious acid. The liver and remaining portions of the viscera were put in a glass jar, covered with dilute alcohol, and sealed December 25th.

On the 9th of February, 1874, that portion of the liver brought to me, weighing thirty-one ounces, was taken from the alcohol, decomposed by Fresenius and Babo's method, and the arsenic weighed as arsenious sulphide. The weight of arsenious sulphide thus found was 1.864 grains, which is equivlent to 1.5 grains arsenious acid.

The subject died three hours after eating dinner, and it is supposed that the poison was given in the food at this time.

As death is seldom caused by arsenic in so short a time as three hours, this case is of interest on account of its showing the rapidity of the absorption of this poison by the liver. The weight of an adult liver is about four pounds. Supposing the weight of this liver to have been sixty-two ounces, the amount of arsenious acid contained in it would have been three grains.

SOME EVIDENCES BEARING UPON THE METHOD OF THE UPHEAVAL OF THE QUARTZITES OF SAUK AND COLUMBIA COUNTIES.*

BY T. C. CHAMBERLIN, M. A.,
Professor of Natural History, Beloit College.

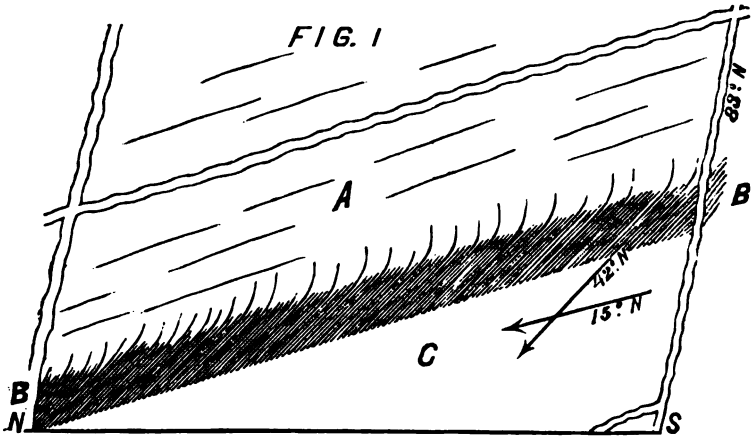
Next to the age of these quartzites, perhaps no question in Wisconsin geology has been more prolific in speculation and discussion, if not in investigation, than the method of their upheaval. The former question has been discussed with much success by Prof. Irving. Evidence bearing upon the latter question cannot then fail to be interesting in itself, while it must also strengthen or otherwise the conclusions that have been reached concerning the former. The evidence which will be adduced in this paper rests chiefly on the peculiarities of certain bands of talco-silicious schist interstratified between heavy beds of quartzite. The best observed exposure of this is to be found on the east side of Devil's lake, and is represented in the accompanying figure.

The dip of the quartzite beds, as well as of the included stratum of schist is 15° to the northward. The determination of this does not rest alone upon the inclination of the beds, but is rendered certain by that of the laminæ and layers of pebbles included in the quartzite, as well as by ripple-marked surfaces. Another similar band, but less conveniently exposed, occurs in the north range near Ableman, standing nearly vertically, corresponding to the higher dip of that range.

The material of these bands is not sufficiently defined by

*It is proper here to state that the observations on which this and the following paper are based, were made in connection with a party organized at Whitewater for the purpose of studying this region, and some credit at least is due to the remaining members though I have made use of my own observations exclusively. The party consisted of T. G. Vincent, S. R. Alden, A. L. Arey, F. H. King, L. C. Wooster, L. W. Winslow and H. D. Bell.

the term talco-silicious schist, although, perhaps, no better single term can be used. It consists of thin laminations of talcose material, separated by somewhat thicker layers of quartzite, presenting a structure quite peculiar. It is neither a typical schist nor a true slate. It lacks the cleavage of the former and the homogeneity of the latter. It cleaves readily along the laminæ of talcose material, which, however, are not entirely parallel, nor always continuous across the band. If an oblique direction is found, it follows the talcose layer as far as possible, when it passes by an abrupt transverse fracture across the intervening quartzite layer to the next tolcose lami-



A, Quartzite; BB, Talco-silicious schist; C, unexposed.

næ, and so continues by alternate cleavage and fracture, resulting in a step-like face. In this sharp distinction between cleavage and fracture, the rock shows its relationship to the true slates. Were it demonstrably a true slate, the suggestions of this paper, now advanced with deference, would be stated as a demonstration. It is the "foliated" structure of some authors, but the foliations are not parallel to the bedding lines.

In the formation on the east side of the lake, the laminations cross the band at an average angle of 27°, having thus a dip of 42° to the north. (See figure.) On reaching the quart-

zite bed above many of the talcose laminae disappear, while a few of the more prominent curve as they enter it until they take a direction more nearly perpendicular to the laminations of the quartzite. Their behavior with the underlying bed was not observed, it being obscured by a projecting shelf of rock, from the surface of which, however, it was inferred that it was the same, the curvature being probably in the opposite direction.

That the material forming this schist and the quartzite beds above and below was originally deposited in an essentially horizontal position, does not admit of doubt. That the material of these talcose laminae was deposited in its present remarkable position and relationship, is not to be supposed. To what then do they owe their origin?

That the lamination and cleavage of true slate are due to pressure is now considered as demonstrated. That pressure is competent to produce such cleavage and lamination has been verified by direct experiment, with homogeneous as well as heterogeneous material. That some of the so-called schists owe their structure to a similar cause, has been conceded by high authority. Mr. Sorby has shown* that cleavage may even be produced in sandy layers included in slaty material, by the pressure which gave rise to the slate. Bearing these facts in mind, let us go back to a time previous to the metamorphism of these rocks. The quartzites were then sandstones and the schist would have been classed as the same with magnesian impurities. The metamorphism of these implies either heat or pressure, or both. But there are no evidences of any source of heat, unconnected with pressure to be found in the region. There are no volcanic or trappean rocks, no deposits of thermal springs. Any source of heat of this character must have been considerable, and should have left its traces, for the area includes more than 150 square miles, about 75 of which are occupied by the quartzite ridges.

*On the Origin of Slaty Cleavage, by H. C. Sorby, Edinburg. New Phil. Jour., 1853, vol. iv. p. 137.

But the fact of upheaval bears its own evidences of pressure. Over all this area, the rocks have been tilted northwards till they dip at angles varying from 15° to 90°. Similar outcrops elsewhere in the state present like phenomena. The common cause of tilting throughout the globe is lateral pressure, and no other cause seems competent in the present case. The same is true of metamorphism, though in a somewhat less degree. The two are usually synchronous events having a common cause. The lateral force usually acts from the direction of the neighboring ocean. This would require, in the present case, a force acting from the south. Let such be assumed to be the case. While the beds were horizontal, the force would tend to produce compression, heat and metamorphism, and as the strata offer the greatest resistance in this position, these results must be supposed to be greatest at this stage. The result of compression would be cleavage in such portions of its rock as were capable of taking it in a direction transverse to that of the force, according to the law of slate formation. The more resisting quartzite would prevent the complete compression of the more yielding schistose material. This is substantiated by the observations of Mr. Sorby. But as the strata yielded, the force would take a new direction relative to the layers and expose the schistose material to farther compression, producing new foliations in a new direction, and those previously existing would be modifed. And so for every change in the strata till the force ceased to act. This is precisely the phenomena presented by the case in hand. Some of the features of what is known as "drag" in slate are unmistakable.

A line drawn perpendicular to the laminae should, if this reasoning be true, represent the direction of the upheaving force. A line so drawn would be transverse to the shore of the Eozoic island to the northward, and precisely in the direction demanded by theoretical considerations.

The fact that the foregoing explanation is so fully in harmony with the usual phenomena of upheaval and metamorphism is at least an element in its favor.

ON FLUCTUATIONS IN LEVEL OF THE QUARTZITES OF SAUK AND COLUMBIA COUNTIES.

BY T. C. CHAMBERLIN, M. A.
Professor of Natural History, Beloit College.

In this paper, the level of the ocean will be assumed as a fixed standard, and all changes will be supposed to take place in the quartzite. This, though not a strictly accurate method, is, I believe, tacitly assumed in the literature of geology.

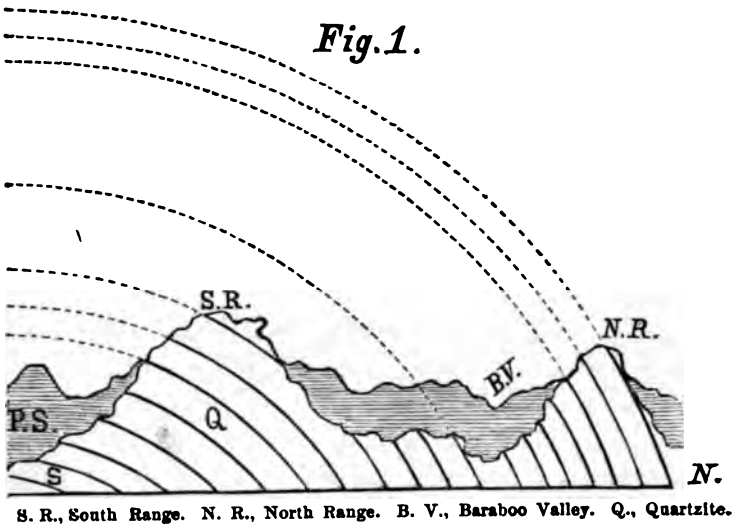
1. Their original position was submarine and essentially horizontal. This is abundantly demonstrated by ripple marks, lines of rounded, water-worn pebbles, and the phenomena of bedding and lamination, and may be dismissed with the mere statement.

2. The position assumed was the result of the tilting and metamorphosis of the strata. That this was one of considerable elevation above the ocean level is more than probable. The sea was shallow during their deposition, as is shown by the mere fact that they were sandstones, and by the evidence quoted above. The sea was also shallow during the Primordial period following, as is shown by precisely similar evidence. So that, unless great depression accompanied the tilting and metamorphosis, an idea that has never, I think, found a place in geology, a very considerable elevation above the ocean must be supposed. This much at least is certain, a vast amount of denudation took place before it assumed the position next to be noticed. To understand this fully the two ranges must not be considered as separate and distinct, but as portions of one grand group of strata, by estimate, 15,000 or 20,000 feet in thickness. The disassociation of the two ranges seems to have resulted from the fact that previous observa-

tions have been confined chiefly to the region of Baraboo, where the ranges are most separated. Their more intimate association, if not direct connection, both at the east and west, was shown in my paper on the geographical distribution of these rocks, and may be seen by reference to the paper of Prof. Eaton, of this volume.

The dip increases from south to north and indicates an arrangement such as is represented in the following ideal section, which also shows the nature and amount of denudation:

Fig. 1.



S. R., South Range. N. R., North Range. B. V., Baraboo Valley. Q., Quartzite. P. S., Potsdam Sandstone.

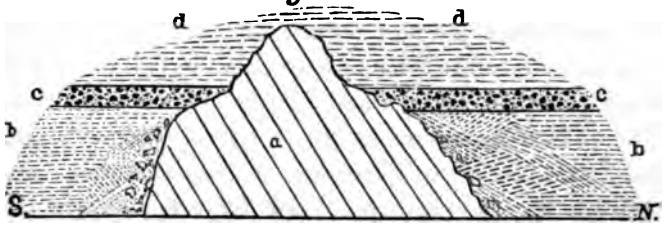
That a portion at least of this erosion was sub-aerial is necessitated by the nature of the case, for in that way only can we explain the deep excavations between and on the outside of the ranges. Preceding the Potsdam period all of these rocks that are now exposed, must have stood above the ocean level, and were doubtless portions of the Eozoic continent.

8. In the earlier part of the Potsdam period, these ridges of quartzites stood as islands in the seas. This is evident when we consider that they exceed, in places, 500 feet in height, while at the base, sandstone, showing cross lamination and

containing *Scolithus linearis* is found, and that a complete submergence would have been incompatible with such a deposit. The greater mass however, of what we are now acquainted with was beneath the surface of the water at some time during that period, though probably not at its commencement, for it is highly probable that a slow subsidence was in progress during this time, and this may have been but a continuance of the depression that constituted the change from the elevated position just described to the present one.

That the shores were precipitous is a matter of observation. That the water along shore, was of moderate depth, is inferred from the nature of the deposit. The following section will render this more clear:

Fig. 2.



a, Quartzite. b b, Potsdam sandstone, showing beach structure and included quartzite fragments. d, Potsdam sandstone. c, Conglomorate.

This is an ideal section, but no feature is introduced that has not been verified by personal observation, and no violence has been done to nature in the combination. It is here used as a convenient substitute for the seven natural sections accompaning the original presentation. I beg leave also to refer to the five natural sections accompanying the paper of Prof. Eaton on the relations of these rocks, to be found on page 125 of this volume. The sandstone formed at this time is marked b b. Near its junction with the quartzite, well defined cross lamination occurs. This is beautifully shown near Ableman. Near the vertical junction there also occur, imbedded in the sandstone, large and chiefly *angular* masses

of quartzite, lying in such positions as to leave no doubt that they fell from above and buried themselves in the soft sands and were thus not subjected to erosion. This may be seen at Ableman, near the western extremity of the outcrop, and in the town of Caledonia, near the eastern extremity, and more than twenty miles distant. It occurs on both the inner and outer side of the range.

From these facts it appears that the deposit was not, on the one hand, beneath the limit of wave action on the shifting sands, nor, on the other, so near the surface as to be subject to the more violent assorting and eroding action of the breakers.

4. There came a time, however, when this last became true and resulted in the formation of a conglomerate marked *cc*, in fig. 2. The well rounded pebbles of this conglomerate are evidently from the adjacent quartzite and vary in size from the fraction of an inch to three or four inches in diameter. The matrix is similar to the under and over-lying sandstones. This is not a mere local formation, as might be supposed. I have observed it at Ableman, at the canon of Narrows creek, two miles further west, where one of the finest sections in the whole region occurs, at two or three points south of this in the towns of Freedom and Westfield, at Devil's lake, at the mill about four miles east of the lake, at the chapel three miles east of the last point, in section 35, town of Caledonia, near the eastern extremity of the outcrop, and again on the north range in section 22 of the same town; in other words, at every point where an opportunity for observation presented itself. As near as could be judged, the elevation at all these points was about the same.

The conglomerate was not observed to exceed 30 feet in thickness, and was usually much less. Its definition both above and below is sharp, and would seem to indicate a sudden elevation which caused the shallow beach necessary to its formation.

In the figure the conglomerate is represented as joining the quartzite on a shelf or terrace such as is often formed by the breakers on a rocky coast. This was observed to be true in some cases, but may not be a general fact, though I suspect it is.

5. Following the period of the formation of the conglomerate, which previous investigations have identified as the Middle Potsdam, there occurred another subsidence indicated by the formation of the sandstone marked *dd*, Fig. 2. This subsidence seems to have continued until the entire formation was submerged beneath the ocean level, and buried beneath its sediment. This, however, I am not able to positively demonstrate in respect to certain portions of the south range. East of the Lower Narrows, resting upon and rising high above the north range, is a high bluff, which presented at a distance the appearance of sandstone, and which I was assured by Mr. Canfield it was. The elevation of this seemed about equal to that of the higher portions of the south range, but I had no means of measurement. Even should its elevation be found to be considerably less, its approximation to the height of the quartzite can scarcely be regarded as less than a demonstration of the fact in question, when it is remembered that at least 400 or 500 feet of sandstone in the vicinity have been swept away by eroding agencies, and that this bluff must have suffered much more denudation proportionally than the quartzite. I conjecture, however, that the quartzite rose into the horizon of the lower magnesian limestone.

On the high bluff just east of the lake, in excavating for a cistern, Trenton fossils in a silicified condition were thrown out. This portion of the bluff does not seem to have been visited by the glacial agencies, although northern drift occurs a short distance east. This will not seem strange when it is known that the drift, even on the lower lands, extends but a short distance west of this. There was no foreign drift discernable in the material excavated or in the vicinity, and the quartzite bottom did not indicate glacial erosion. These facts

whatever may be thought of their force or conclusiveness, are at least interesting.

6. Subsequently the whole was elevated above the ocean, and, whatever fluctuations may have intervened, stands there to-day, testimony to which this academy has received, perhaps, *ad nauseam.*

ON A HAND SPECIMEN, SHOWING THE EXACT JUNCTION OF THE PRIMORDIAL SANDSTONES, AND HURONIAN SCHISTS.

BY ROLAND IRVING, A. M., E. M.,
Professor of Geology in the University of Wisconsin.

On Black River, in Jackson county, this state, in the vicinity of the town of Black River Falls, the Primordial sandstones are found overlying Huronian and Laurentian rocks. About a mile or two above the town the banks of the river are formed of abruptly rising and as abruptly sinking mounds of tilted Huronian schists,—chloritic, talcose, talco siliceous, siliceous and ferruginous. Between these mounds, the depressions are filled with the light colored quartzose Primordial sandstones of the region, and these often form the bank of the stream. So close is the association of these formations, that in following the bank of the stream, one is constantly stepping from the Primordial sandstones, on to the Huronian schists, and then as abruptly back again. In many cases the sandstones form the upper part of a high bank, whilst below, immediately at the water's edge the schists are visible. In these cases the exact junction of the sandstone and schists is nearly always concealed by debris, soil and undergrowth. In one place, however, Mr. T. B. Bowman, assistant on the geological survey, found a long exposure showing the exact line of junction, the horizontal sandstones above, and the ferruginous schists below. From this place he obtained specimens, of which I exhibit one. It will be noticed that even the hand specimen shows the horizontal position of the sandstones and the inclined position of the schist, or "iron ore" the lamination being marked. (See sketch.)

ON THE OCCURRENCE OF GOLD AND SILVER IN MINUTE QUANTITIES IN QUARTZ FROM CLARK COUNTY.

BY R. D. IRVING, A. M., M. E.

Professor of Geology in the University of Wisconsin.

In the fall of 1871, some samples of quartz from Clark county, Wis., were handed me by Mr. Geo. W. Brown, with a request for an assay for Gold and Silver. The samples were barren looking, tough, white quartz, presenting none of the reddish or rotten appearance common to surface Gold ores of any value. Scattered throughout the quartz, were small quantities of Magnetite in scales, Pyrite and Arsenopyrite; this association being a usual one in Gold quartz. Mr. Brown pointed out the locality from which the samples came in Clark County just north of the junction of the Potsdam Sandstone with the Eozoic rocks. He represented the prevailing rocks in that section as Chloritic and Talcose Schists; and of the former he brought me fine specimens. The quartz he represented as occurring in veins; though his samples seemed to have been selected from loose masses. I need hardly say that these associations are the common ones in Gold regions. On taking the usual amount, four (4) Assay Tuns., or about 120 grns., the resulting button of bullion weighed just enough in excess of the Silver in the Litharge used, to make me suspect the presence of Gold in the quartz. On dissolving the button in Nitric Acid, one or two small flakes remained, but not enough to weigh. I then took for a second Assay, four times the usual quantity and obtained a weighable amount of gold, corresponding to about 20 cts per 2,000 lbs of ore.

Mr. Brown subsequently, at my advice, sent me samples, showing the reddish and rotten appearance already alluded to.

The result of the assay on these samples, however, was the same as before, save that in this case, the difference between the weight of the button obtained and the silver in the lithurge used, was not fully made up by the weight of the gold; the presence of silver was thus indicated. In making a further assay some time afterwards, I obtained an unmistakable amount of silver. And during the fall just past, Mr. Theodore Bowman, of the University, made two assays, in which he obtained the following results:

PER 2,000 LBS. OF ORE.

1st Assay.		*2d Assay.*	
Gold	A trace.	Gold	A trace.
Silver	0.407 oz.	Silver	0.37 oz.
Total	0.407 oz.	Total	0.37 oz.
Gold	A trace.	Gold	A trace.
Silver	$0.52	Silver	$0.47
Total	$.52	Total	$0.47

DEPARTMENT OF THE ARTS.

ON THE WISCONSIN RIVER IMPROVEMENT.

BY W. J. NICODEMUS, A. M. C. E.,
Professor of Engineering, in the University of Wisconsin.

Before speaking of the physical features of the Wisconsin river, we will offer some general remarks applicable to the whole of North America. Recent surveys show that Lake Winnebago formerly had its outlet southward to the Wisconsin river, and since changed to the north through the lower Fox river into Green Bay. It has long been known that Lake Michigan once had its outlet southward through the Illinois river, and that Chicago stands in the old bed of the lake, the southern shore of which is twelve miles south of the city. All the small lakes examined show the same condition, an elevation south of a line drawn from Cape Hatteras on the Atlantic to Cape Mendocino on the Pacific, and a depression north of that line. If this supposition be correct, going back in time, the lake outlets would all be southward, and not northward as at present. Hence we would infer that the Niagara and probably the St. Lawrence rivers (though there are signs of greater antiquity connected with the last), are of comparatively modern origin, which is confirmed by the fact of their abounding in waterfalls and rapids. There is no doubt that Lake Winnipeg was once continuous southward, covering the central portion of the valley of the Red River of the North, and having its outlet down the Minnesota River, and not as now, down the Nelson river to Hudson's bay. The river bank near the old out-

let show that this change took place since the glacial period. The ancient Lake Winnipeg was larger than the present Lakes Superior and Michigan combined. The northern depression is known to be going on along the Atlantic coast from New Jersey to Greenland. Any one can test the matter of northern depression and southern elevation for himself by examining the published maps, and remembering that the effect of bodies of water on the shore is to abrade it and spread the material smoothly over the bottom, while the effect of the atmosphere is to cut the land up in ridges and to wash the soil from the rocks; so that the land rising from the water will have comparatively smooth outlines, and successive lagoons parallel to the shore, while the land going under the water will show jagged and sharp outlines, with deep indentations and numerous islands. We know that during the cretaceous period, an ocean extended from the present Gulf of Mexico to the Arctic Ocean, covering a large portion of the space between the Missouri River and the Rocky Mountains. At that time the country through which the Upper Mississippi now flows was dry land, and its slopes must have sent its water westward to that cretaceous ocean. As the continent rose this ocean disappeared, and the tertiary period began with great fresh water lakes along the Rocky Mountains. Into these lakes the waters of the upper Mississippi region continued to drain westward. The gradual southwestern elevation of the continent throughout the testiary period is distinctly proved by the deposits of the testiary lakes. The earliest deposits were of the least area, and as they become more recent they expand northeastward, and this action continued apparently to the time preceding the glacial epoch. Preceding the glacial period, then all the water-courses westward of the upper Mississippi region were westward and not southward, as now. Not only the slope of the land but the great folds of the Silurian strata compelled the water to this course. Over a great deal of the region thus drained, no rocks more recent than the Silurian are found, so

that it must have been dry land since the Silurian period. In the immense ages succeeding the time of the Silurian oceans, the rocks being exposed to the destructive atmospheric influences must have been cut up by the ravines and valleys encroaching on each other in endless confusiou. The pre-glacial erosions of even the hard Azoic rocks which formed the dry land of the Silurian period can still be distinguished from those made since. When the glaciers came they planed down the whole region of the upper Mississippi river, removing silurian strata 500 feet in thickness over hundreds of miles. The southwestern limit of the glacial drift action is the Missouri river from the 48th down to the 43d parallel of latitude. From the Missouri river to the Rocky Mountains, over a space varying from 300 to 500 miles in width, there is no drift. The motion of the glacial mass must have been along the line of least resistance; and towards this limiting line, the glacial scratchings in the northwest show that the glacial motion was southwest. There, then, on that limit, a river must have been formed to carry away the melting water from the glacier, and this limit was the Missouri river, and that was the river so formed. As the glaciers began to retire to the northeast, as long as the general slope of the plain was towards the glacial mass, successive rivers were marked out by it along the western face; and all have a parallism and are close to each other, and have short tributaries or parallel branches, if any. There are, besides minor streams, the James, Big Sioux, Des Moines, Iowa and Cedar rivers; and finally the Minnesota and Mississippi the last of the parallel rivers. After the lowest line of the continental valley was passed, the glacier would retire, so that the melting water would run directly from it, and thus we see the origin of the tributaries of the Mississippi on the east side.

This direction corresponds with that of the pre-glacial rivers, and it is probable that many of them were washed out and regained their old beds; such as the St. Croix, Chippewa and

Wisconsin rivers, and is confirmed by their appearance. From the foregoing we infer that the Wisconsin River was in the trough of what was formerly a far mightier stream; that the ancient river was not only greater in volume, but cut deeper into the bed through which it flowed; that this ancient bed is composed of the silurian or older rocks and is silted up many feet deep. Such are a few of the facts which geology lays before the scientific engineer to guide him in making his plans for water improvements. A knowledge of the old channels of our rivers would have prevented the folly of making a canal through the solid rock in order to avoid the falls of the Ohio at Louisville, instead of digging through the drift of the old channel of the river. Instead of probing with an iron rod every inch of the bed of the Mississippi before we can determine the practical depth at which firm rock may be reached, geology steps in and tells us it will be found at a depth of at least 60 to 100 feet through the sand, with two remarkable exceptions at the rapids, one at Keokuk, the other at Rock Island. These exceptions are readily accounted for, when we know that the whole valley of the Mississippi was covered with an extension of the Gulf since the glacial period as high up as Savannah or Dubuque. That the silt brought in by the Des Moines river in the one case, and the Iowa and Rock rivers in the other, during this period, filled up entirely the valley cut out by the great glacial river, and that when the land rose again the Mississippi could not at these points regain its old bed, so it had to cut a new one, which is not yet completed. There is no doubt that Lake Erie had formerly an outlet past Fort Wayne, Indiana, and down the Wabash valley, which indicates the natural course for water communication between the lake and the Ohio river.

From these general remarks which will be recognized as germane to my subject, I will now turn to its special consideration. The main features of the Wisconsin river are common to northwestern rivers. First, there is a high bluff on

each side of the river valley, from one to ten miles apart, and from 100 to 400 feet high, composed mainly of horizontally stratified rocks; and in the case of the Wisconsin, of Magnesian Limestone of the Silurian formation. The slopes, however, are often covered with earth and green grass. The sand feature is a level or nearly level terrace mainly composed of sand, though occasionally having a rich surface soil. This terrace is from 20 to 60 feet above the level of the water. It is never continuous throughout the valley on either side, and rarely of much extent but on one side at a time. It is probably the shallow part of an ancient water-course which once occupied the valley from bluff to bluff. It is now generally above overflow. The third feature is the bottom land of the river, generally overflowed at highest stages, and having the high bluff or terrace for its margin. This bottom contains many lakes and marshes, and is cut up by sloughs forming islands. These islands sometimes divide the main stream into nearly equal parts. The margins of these bottom lands are, in the natural state, generally wooded, and form the banks of the streams at moderate stages when the sand bars are covered. The fourth feature is the bed of the stream, which includes the part covered at medium stages, but large portions of which become dry sand or gravel bars at very low ones. There are thus four different prominent branches or levels in the river valley: 1. The level forming the main bluff. 2. The sand terrace generally above overflow. 3. The bottom land generally overflowed at highest water. 4. The bed of the stream. In 1867, a careful survey under direction of Gen. Warren was made of the Wisconsin river from Kilbourn City to its junction with the Mississippi river. A continuous transit line was carefully measured and staked off on one bank or the other of the main river, as was found most easy and all the topography sketched along it. The opposite shore was located by triangulation across. A careful line of levels was run, noting frequently the height of the bottom lands, or sand terrace when

near, the height of the water at the time, that of the last high water, and the most noted high or low water mark ascertained. Besides the parties who ran these main lines there were two subordinate compass parties who surveyed the minor channels making connections with the main line as often as possible, a cross section level party and a sounding party. The object of this survey was to determine the practicability of improving the river so as to form part of a line of communication by steamer from the Mississippi River by way of the Wisconsin River, Upper Fox, Lake Winnebago and Lower Fox River to Green Bay, and thence with the lakes. For this improvement Gen. Warren submitted three plans. 1. By means of a series of wing dams. etc., and the use of Long's scraper, so as to make it navigable for boats drawing three feet water. Estimate $428,000. 2. By use of natural channels in connection with side-canals of sufficient width and depth for steamboats drawing four feet water. Estimate, $3,207,000. 3. By means of a canal designed for steamboats drawing five feet water, built along the valley, alternating from one side of the river to the other, as circumstances demand, and using the natural bed of the river for crossings. Estimate, $4,164,000.

In 1871, Col. Houston, U. S. Engineer, was directed in accordance with these plans to improve the navigation of the river at those points where the proposed canal was to cross the river, and in doing so to determine the practicability of improving the river itself. The proposed canal starts from a point on the canal now connecting the Wisconsin and Fox rivers, near Portage City, where it connects by a lock with the river. The canal then commences on the opposite bank of the river and proceeds on the right bank to a point about 56½ miles below Portage, when it again connects with the river by a lock. Commencing again on the left bank opposite it proceeds to a point 88⅝ miles below Portage, when a similar crossing becomes necessary, and then proceeds on the right bank to Prairie du Chien, when it connects with the Missis-

sippi river. The depth of the proposed canal is for vessels drawing five feet, and the lengths of the river to be improved to enable boats navigating the canal to cross the river, are, at the upper crossing, 2,300 feet; at the middle crossing, 7,000 feet; and at the lower crossing, two and a half miles. There are two classes of obstructions. Those arising from causes not now operating and which once removed will not return, and those arising from causes now operating and which must be constantly recurring until the cause is removed. In this latter class we find sand the chief obstruction to the improvement of the Wisconsin river. What shall be done with it? This problem, John Nader, Assistant U. S. Engineer, under direction of the U. S. officer above named, has been endeavoring to solve, since July, 1871. He finds the sandbanks of the upper river the cause of the sandbars below Portage. That wherever the river is contracted between narrow banks, the sandbars will form only behind projections or obstructions, and in this case tend to improve rather than obstruct the channel; also occasionally, where the river is moderately wide, sandbars are found to have lodged on one side or the other (probably caused by some obstruction) and preserve a good channel; but where the stream is straight for some distance, and of considerable width, there will be formed a middle ground, with but little water over the same, and sometimes a dry bar; in either case the channel is on one side or the other, never on both. Where the middle ground is flattened out, and extends across the whole width of the river, one side of the bar advances more rapidly than the other, and the crest of the bar is formed obliquely across the river; the current generally flows at right angles with the line of the crest, and the width of the river is virtually nearly doubled in some cases; in nearly every case, deep water is found along the crest of the bar. The motion of the sandbars is quite regular, and depends not so much on the stage of the water as upon the rapidity of change from high to low, and upon the velocity of

the current. During a continuous stage of water, the movement is slow and regular, and the bars are moved along as an obstruction by the pressure rather than by the velocity of the water, rolling slowly and steadily along the bottom with no floating sand, until the equilibrium is disturbed. When moved by the velocity of the water, they move quite rapidly, and the sand is found floating in the water in quantities. He gives an instance of a bar above Steamboat Slough, containing a uniform depth of water of twenty-two inches at a certain stage of water. After the water had fallen twelve inches, the same amount was found; also subsequently when the river had risen again a little above its former stage, still the same amount of water covered the bar, clearly indicating the existence of equilibrium between the current and weight of sand. In order to determine the most favorable condition of equilibrium to preserve a good channel, a section was measured near Lone Rock, where the channel is quite uniform for several hundred feet, and the stream at low water is confined to one channel of 325 feet between banks; the greatest depth was 7.4 feet, and the mean depth six feet, giving the cross-section of 1,950 square feet; a series of floats gave a mean velocity of 1.95 miles per hour; the channel in question always preserves a uniform depth, and is free from sand-bars. As there are many similar places on the river, it will be safe to assume from these the necessary section for any required depth of water.

Aside from the sand bars, the only other obstruction to navigation are the railroad bridges and the principal difficulty with these is that they are built obliquely across the stream; the water is thereby inclined to flow to the bank at the down-stream end; whereas the draws of both the Spring Green and Lone Rock bridges are at the opposite or up-stream end; in addition to this the draw spans are very narrow; and still more contracted by the piles and protection of the pier-foundations, making the entire available width at low water about

36 feet only. The experimental improvement was made by building wing-dams at suitable points along the line to be improved. The plan adopted required only the use of brush, with sufficient stone to retain the same in places and the addition of gravel to prevent leaks under the brush. The brush was made in fascines of 11 feet long and 13 to 15 inches in diameter, securely bound. The fascines were then formed into mats of about 9 feet wide, by placing a number of fascines side by side, and placing light poles on top and bottom, and tying the ends of the poles with twine. Having determined the position of the dam with stakes driven into the sand, a sufficient number of mats were prepared as above stated, and a quantity of stone and sand bags being in readiness, the work was commenced. The mates were floated into position and sunk by placing stone and sand bags upon them. They were placed side by side in the line of the draw, and the bottom row carried to the entire required distance; the brush ends or tops were placed up stream, and after the first course was laid the tops were covered with a layer of gravel, to prevent undermining; and the remaining courses were carried up in the same manner; each course was brought forward from 2 to 4 feet in order to break the fall of the water. After the dam rose a little above low water, a substantial layer of loose brush was placed along the entire face of the dam, and covered with a layer of stone, and then with sufficient gravel to stop all leaks. The general effect of these dams was the usual effect of contractions; the water was elevated above the contracted part in some cases as much as six inches, but subsided again as the channel accomodated itself to the change. In the case of cross dams, a general movement of sand took place for some distance above, and to a considerable distance below the work; and as soon as the current was checked there was a deposit of sand in front of the dam in its whole length. As soon as the dams were brought to the surface, there was a rapid deposit of sand and below the same; that above was concave, and that

below convex to the axis of the stream. In connection with the work, observations were made of the movements of sand bars, and the effect of the work upon them. The movement at Portage was from 3 to 5 feet per day which seemed to be the average upon the river unless disturbances occured. At Dekorra the effect of dams caused a movement of from 7 to 14 feet in twenty-four hours, and at Lone Rock from 6 to 20 feet in twenty-fours hours. The bars moved along at this rate until reaching the dams, and then receded as rapidly and disappeared, the sand being deposited behind the dams. From the result of the work it would appear that it is only necessary to contract the stream proportionate to the required depth, everything else depending upon the stability of the dams, of which he has not the slightest doubt, as he considers the test which they withstood, when in an early stage of progress, the water poured over the same in an entire sheet, as much severer than any resulting from high water. Concerning the stability of the channel produced, the question arose as to whether high water with increased pressure and velocity would not continue excavating the same until banks and dams would slide in, and the channel become useless; this gave rise to an examination of the river where the same is confined to a narrow channel, so that its depth is from 6 to 8 feet at low water; at such places the bottom is found to be composed of coarser material and gives considerable resistance to the thrust of a pike; the bottom always remains the same excepting during the passage of a sand bar during a freshet.

For my own part I think the canal project by far the mos preferable. As the work will be principally excavation in sand and loam it can be done with proper machinery at a comparative small cost. When once completed it can be maintained at small cost. The banks as proposed will be above high-water mark in the river and consequently not be liable to damage from floods. No estimate need be made for feeders. The Wisconsin river will constitute a natural

feeder. The daily discharge of water in the Wisconsin at Portage City is 259,000,000 cubic feet; not less than 3,000 cubic feet per second. The total daily supply of water for the Erie canal of Pensylvania, enlarged with a prism greater in area than the one here proposed, is less than 20,000,000 cubic feet—about 231 cubic feet per second—not one-twelfth of the amount available in the Wisconsin, and yet the Erie canal, which is 136 1-2 miles in length, and has a lockage of 926 feet, has sufficient water to pass through the locks 144 boats per day, or to carry through the boating season 5,400,000 tons of freight. The Dalles, which is a gorge in the rock about 23 miles above Portage, reduces the river at one place 54 feet, so that the extreme of fluctuations from low to high water below the Dalles does not exceed 10 feet, and arrangements could be made, besides supplying the proposed canal, to turn only the desired quantity into the Portage canal and Fox river. Freight could be carried by this line for about one-fourth of what they can by railroad. In view of the great and increasing amount of grain annually shipped to the east from the west of the Mississippi, it should be constructed at the earliest practicable day.

THE STRENGTH OF MATERIALS AS APPLIED TO ENGINEERING.

BY JOHN NADER,
Assistant United States Engineer.

The subject herewith presented deserves, and in fact requires, particular attention.

It is not the intention to give tables and formulæ on the subject in question, but only to discuss the obscure, uncertain, and therefore unreliable, manner in which information is placed before the public, and, in such a manner as to call the attention of this and other scientific societies to this subject, in order that at sometime, and I hope not a distant day, something reliable may be obtained on the subject, either from existing data or from those obtained from special researches. Barlow and Hodgkinson appear to be the favorite authorities; but, if these authors have experimented on wood of which we have no knowledge, or if we have, cannot obtain or make use of, of what use is repetition of the record of their experiments?

In examining a set of tables on the strength of timber, what a useless lot of materials do we meet with, for instance, crab, elder, plum, willow and the like; and in passing to the useful, how are we not mistified by the simple word deal. This in its real sense means nothing more or less than the wood of the fir or pine, yet we find in most of these copied tables no less than four kinds of deal, the same number of firs, and also the same number of pines. The question now is, how is all this to be reduced to common sense or practice?

So far as other timbers are concerned, the matter is not quite but nearly as obscure as deal. This dealing out of spurious

matter cannot be too severely criticised, and the time must and will come, when such information will be accepted only from scientific organizations, where the same will have been thoroughly discussed before passing to the public.

In iron, the matter is not quite so bad. Iron being a valuable material, and a saving in weight of importance, so that an excess in any structure over and above that which was actually necessary, would be a very expensive as well as worse than useless application. This simple fact brought about a number of experiments by able and reliable men, some of whom made a specialty of the subject and deduced formulæ which are now in general use.

Some valuable and carefully calculated tables on the strength of columns were published in 1860, by Mr. G. P. Randall, in the Architects and Mechanics' Journal, and by Mr. Wm. Bryson, in the Journal of the Franklin Institute. Both were calculated from the formulæ of Prof. E. Hodgkinson. Mr. Randall assumes one-third of the breaking weight as the weight of perfect safety, and thereby makes no allowance for a misfit; and since a pillar imperfectly set is less than one-third the strength of one properly fitted, this fact should have been taken into account. Mr. Bryson, on the other hand, adopted one-tenth of the breaking weight as the weight of perfect safety, and carefully computes the minimum quantity of metal which will support the weight under the assumed conditions, and at the same time he is on the safe side in case of imperfect workmanship.

Quite recently an article comes from England which is not only at variance with previous data, but contrary to all accepted laws. The following is the article:

"STRENGTH OF IRON INCREASED BY STRAIN.—Some experiments recently made in England to ascertain the effects of strain on wrought iron, give results quite at variance with the supposed data of previous experiments, and are therefore worthy of attention. It is usually supposed that the effect of strain is to diminish the strength of iron, but if

these experiments are to be trusted, the contrary appears to be the case, and that very heavy strains, even to the extent of the breaking strain, and this even several times repeated, actually increases the strength of iron by every application. The result of several experiments are stated as follows on 'Iron':

"1st fracture, mean breaking strain of 33¼ tons; 2d fracture, 35¾ tons; 3d fracture, 37¼ tons; 4th fracture, 40⅛ tons; diff. 6$\frac{1}{12}$ 20 per cent.

"'These facts,' says the official report, 'appeared so important, and were so much opposed to the opinion of the best informed persons upon the subject, that in order to prove beyond all question that the increased strength was due to the repeated previous strains, and not to the diminished length of the bar, we considered it proper to make experiments upon this point.

"'We therefore took several bars of the same kind of iron, of the same diameter, but varying in length from ten inches to ten feet, and found they were all equally strong. It may be proper to state the circumstances which usually attend the fracture of iron bars, namely, that considerable heat is evolved at the breaking place, and that the diameter of the bar is everywhere reduced, but particularly so at the place of fracture; but it is worthy of remark that at the second and subsequent fractures of the bars, it generally happened that little or no heat was given out at the place of fracture, and that the general diameter of the bar was not again sensibly reduced, except in some instances, at the place of fracture.' The publication of these results in a government blue book is sure to attract general attention to this important question."

I should say it would.

All experimenters, without any exception, men who have made this problem their particular study report results in contradiction to the foregoing article. In reading the above, the question would occur to some, Who would think of testing a bar after the same was once broken or injured? But it seems that experimenters did think of it, and they did also faithfully report the results, and furthermore, they all agreed exactly upon this point, more so than upon many others. Their uniform reported results were: that the strain exceeding the limits of elasticity and producing permanent elongation, could not be borne for any considerable length of time. Yet it might be argued that the relaxation of the strain would have had some influence on the results. This, however, was also thought of by

Fairbairn, who made tests a little beyond the elastic limits, re moved and reapplied the same weight a number of times, and ultimately produced fracture with a strain much less than that which would have done so if the first strain had been carefully and gradually increased.

From a common sense point of view alone, it would appear as though a bar of iron of uniform section would be permanently injured by a breaking strain, since at the moment of rupture the particles would be all uniformly strained and ruptured until the break occurred at some point of mechanical or other imperfection, the remaining portions would remain in their almost entirely ruptured condition. In my experiments on timber I found that the strain which produced a permanent set would break the same, and that a less weight applied for a longer time would also produce rupture if the specimen had been injured previously.

The heat evolved by tearing asunder a bar of iron is common to violence, and is the result of friction produced by the excursion of the molecules, simply denoting work done. The almost entire absence of heat in the subsequent fractures in the aforementioned experiments would go to show that the work had already been done. I have purposely dwelt upon this subject to invite inquiry, and have based my arguments not upon my own, but upon the knowledge of men who have been the leaders of special branches of science and industry. Another case more serious than the former frequently makes its appearance in lengthy articles; it is the effect of frost upon the strength of iron and steel. The subject is a comparatively new one, and has but very recently been seriously considered by scientific men.

Railway companies have been in the habit of attributing every accident in winter by broken rails or axles to the effect of the frost upon the metal. In some manner this led to investigations, and several have appeared who have attempted to refute the idea entirely, and who endeavor to prove that

frost, instead of weakening iron, on the contrary strengthens it. That this should be so, in respect to axles and rails in *extreme* cold, remains yet to be proven.

Papers on the subject have been read before several societies and associations, one of which I will here introduce and then discuss its merits.

"EFFECT OF FROST UPON IRON AND STEEL—(From 'Nature,').—From papers read before the Manchester Philosophical Society, Dr. Joule made experiments with iron and steel wires stretched through a freezing mixture, so as to be part within and part without. In every case tried the wire broke outside of the mixture, "showing that it was weaker at 50° Fah. than at 12°." Also further experiments on darning needles, supported on steel props 2½ inches apart and weights suspended from the middle. The average breaking weight of six needles at 55° Fah. was 58½ oz., and that of six at 12 degrees was 59⅝ oz. The next experiment was with cast iron "garden nails," 1¼ inches long and ⅛ inches thick; they were supported on props 1 1/16 asunder and a blunt-edged steel chisel weighted to 4 lbs. 2 oz. was let fall from a given height upon the middle of the nail. Twenty-one cold nails broke and twenty warm ones. "The general conclusion," says Dr. Joule is this: Frost does *not* make either iron (cast or wrought) or steel brittle, and accidents arise from the neglect of the companies to submit wheels, axles and all other parts of their rolling stock to a practical and sufficient test before using them. Mr. Spence also made experiments on cast iron bars of ½ inch square, supported on knife edges nine inches apart and suspended weights from the centre by means of a knife-edged hook to which was attached a scale pan. The average breaking weight of six bars at 60° Fah. was 4 cwt. 4 lbs. and of six bars at 0° Fah. was 4 cwt. 20 lbs." being an increase of 3½ per cent."

Further evidence to the same effect has been furnished by M. Caron of Paris, the result of whose observations on the fracture of car axles, have lately been laid before the Paris Academy of Sciences. He finds, in every case, that the break is due to the bad form of the pieces or the faulty nature of the iron; and denies that bar iron becomes crystalline and brittle under the influence of winter cold. This denial is based on the following experiments: Several pieces of good bar iron were exposed for four months in an ice factory, to temperature

varying from 0 to 19°. Others were allowed to remain throughout the cold of last winter, 1872 and 1873, exposed to a temperature of about 20° in the open air. The bars were broken, both in their cold state and after raising the temperature above 0. In no case was there any appearance of crystallization. Mr. Caron attributes the breaking of rails in winter to the greater shock to which they are subjected on the frozen ground and to inferior qualities of iron.

Should the publication from which I took my information be correct, neither Doctor Joule nor Mr. Spence have proven anything which I did not consider a fact, viz: that the specimens tested by the former were stronger at 12° Fah., than at 50°, or that the difference were uncertain, and that those tested by the latter showed as great, or a still greater difference than 3½ per cent. existed in bars of cast iron of 1-2 inch square. There is no doubt that a great many fractures of rails and axles occur from the faulty nature of the iron, but these occur at all seasons, and, as a general thing, it is difficult after a railway accident to say what broke first. All that I could discern in several cases was an indescribable wreck.

From my experience with various kinds of implements and machinery, I have every reason to believe that iron and steel become stronger under a moderate degree of frost to a steady strain, but that from a very moderate to an extreme degree of frost they are exceedingly more susceptible of fracture from impact than when not frozen. The latter is well known to every mechanic who endeavors in every way to guard against the results. I had hoped to make some experiments, and made some preparation for the purpose, but found that I would not be able to produce the same in time for the present meeting of the Academy. I will conclude by noticing a few special cases of application. The entire weight of a structure, such as a bridge or roof, together with its passive or accidental load, is borne by the points resting upon the walls or abutments, and the plates and bolsters, if of wood, receive the en-

tire strain in a direction perpendicular to their fibre; I have found that American white pine will not bear a strain greater than five hundred pounds per square inch under these conditions, and that even less than this will leave a permanent impression; no regard is however paid to this fact, and it is very common to find premature rot produced in wall plates, bolsters and chords of bridges, by a partial crushing of the timber. The same is also true with regard to the bearing of brace-blocks in bridges.

A similar fact came to my notice. It was that of an ice house. The ice, to the amount 200 tons, being packed on the second story, the entire floor was constructed to bear its proportional weight per square foot of the entire mass. The ice was packed and supported safely until towards the close of the first season, when the mass, by use and thawing, was reduced to less than one-half, when suddenly the center portion of the floor began to bend and finally to break, requiring a number of props for safety. Before the packing of the second season, additional joists were placed between the broken ones and a straining beam under all, and suspended at intervals of nine feet from trusses above; still, at about the same time as in the previous season, the centre interval broke. I was called into consultation and examined the case carefully. I found that, after admitting a loss of one-third the strength of the timber from moisture, the original floor should have safely supported the entire weight desired, provided the same had been uniformly distributed. This led me to re-examine the matter. I found that the ice, which was a solid mass, had melted beneath from the heat conducted by the zinc-covered floor and assumed a convex form, so that the center joist, which would break at sixteen tons, broke when overloaded, and its companions in turn, until the spherical segment in contact rested upon a sufficient number of joist to support it. This is not by any means a singular occurrence, but I doubt if the same has been taken into consideration by builders.

I would add a word with regard to obtaining coefficients and formulæ for computing the strength of materials. As a general thing, experiments are continued until fracture takes place, and a fractional part of the breaking weight is taken as the coefficient of safety. The specimens must also be of limited size in order that they may be broken by ordinary means. Hence the results would be doubtful in two respects: 1st. There would be a flexure not admissible in practice with even a fraction of the breaking weight. And, 2d. The specimens must necessarily be selected, and would differ from material used in practice. (These remarks are in reference to wooden beams.) Mr. Wm. Hearding in making experiments on the retaining power of large bolts in wood, found that the resistance to a transverse strain in very strong beams was materially different from accepted data. I would hence suggest, that in experiments the strain producing the extreme flexure admissible in practice be taken as the safe strain; it would then be possible to use specimens of large dimensions, even those used in practice, and also for comparison to subject some to a breaking strain. Parallel with the strength of materials is an accurate knowledge of the weight of all materials used in construction and especially in their applied form. Considering the subject in question one of great importance, I have determined to make the same a specialty and will convey the result of my investigations to the Academy as occasion may permit.

RAILWAY GAUGES.

BY W. J. L. NICODEMUS, A. M., C. E.
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The great need of this country is cheap transportation. All sections would have railway facilities if they had the money or could borrow it at a reasonable rate of interest. As the narrow-gauge will do all the business of any section of the country with a much less bonded debt, it tends to give a better security to the bonds and stock of the roads, making a better sale for the same, and in that way furnishing many feeders to our present through lines which would not otherwise be constructed, and soon connecting lines so as to make new through lines of the three-feet gauge, north and south as well as east and west. Experience has shown that in very rough mountainous countries the narrow-gauge can be built for the transportation of ores, such as gold, silver, iron, copper and other minerals in bulk, before reduced, so as to collect the same at the various smelting works, with the coal, wood and fluxes used in their reduction and manufacture for about one-fifth the cost of such roads as the Erie, Pennsylvania Central, and Baltimore and Ohio; that in the broken rolling country, where most of our roads are located, the cost will be about one-half as much as that of present broad-gauge roads; and in the slightly undulating prairie country the cost will be about three fifths. As it is easier to raise $10,000 per mile than it is $30,000, in the same ratio is it easier to construct the narrow gauge than the broad gauge. Where the light business of a road would not justify the construction of a broad-gauge, or if one were constructed, the

high rates would rather retard than stimulate development, the construction of the narrow-gauge would offer good inducements to capitalists for investment and furnish cheap transportation for the people. Comparing the cost of operating the two gauges we find that the narrow-gauge coach, weight 12,000 pounds, carries, when full, 36 passengers, with a dead weight of 12,000 divided by 36=333 pounds per passenger, while the broad gauge coach, capacity 56 passengers, weighs an average of 19 tons, giving a dead weight of 38,000 divided by 56=678 pounds, a difference of 345 pounds per head in favor of the narrow-gauge. But these coaches seldom run full, in which case the advantage will be still greater in favor of the latter. Suppose we have 38 passengers, two more than the small coach will accommodate, making it necessary to put on a second one. Here we will have two narrow-gauge coaches weighing 24,000 pounds, or 24,000 divided by 38=634 pounds per passenger, while by the broad-gauge we have 38,000 divided by 38=1,000 pounds dead weight per passenger or a difference of 366 pounds per head in favor of the narrow-gauge. Again, let us suppose that we have two narrow-gauge car loads, 72 passengers, or 16 more than can be accommodated by one broad-gauge coach, necessitating the use of a second one. The account will then stand as follows: two narrow-gauge coaches, 72 passengers, 24,000 divided by 72=333 pounds per passenger; while by the broad-gauge it will be, two coaches 76,000 divided by 72=1,055 pounds per passenger, a difference of 722 pounds per passenger, or a total of 52,000 pounds, or over 26 tons' saving in dead weight in favor of the narrow-gauge in only two cars. The dead weight per passenger on roads in Massachusetts in 1870 was 1,250 to 2,782 in New York. In New York this was exclusive of baggage, with an average of 13 passengers per car. On a large majority of roads the average dead weight is much greater. The passenger coaches, then, on the New York roads, run about one-fourth full. Assuming that our broad-gauge rail-

ways average the same number (13) per car, we have the following table:

Kind of Traffic.	Gauge.	No. of Passengers per car.	Weight of car in pounds.	Total paying load in lbs.	Dead weight of passengers in pounds.	Gross load in pounds.
Passenger....	Broad	13	38,000	1,950	2,923	39,950
	Narrow ...	13	12,009	1,950	923	13,950
			26,000		2,000	26,000

A difference of 26,000 lbs. or 13 tons, in favor of the narrow gauge, or 2,000 lbs. per head per passenger. Assuming the weight of the broad-gauge car to be only 15 tons, or 30,000 lbs., the difference in favor of the narrow-gauge cars will still be 18,000 lbs. or 1,384 lbs. per head for each passenger, as against 923 lbs. per head by the narrow-gauge. So much for passenger traffic; now let us see how the account stands with regard to freight. The average weight of the most recently constructed broad gauge cars is 20,000 lbs., capacity 20,000 lbs. The average weight of the southern broad-gauge cars is 18,500 lbs., capacity 16,000 lbs. But to make it as favorable as possible we will consider their weight to be 18,500 lbs., capacity 20,000.

Gauge.	Freight of box cars in lbs.	Capacity of box cars in lbs.
Broad....	18,500	20,000
Narrow	8,000	16,000
		4,000

The average pounds of dead weight to one ton of paying freight carried on railways in Massachusetts and New York in 1870 was:

Massachusetts ..... 3,136 New York..... 3,109

By this we see that the railways of Massachusetts and New York average only about one-sixth of their capacity. The general average of our railways will fall far short of this, especially in the agricultural districts of the South, West and Northwest.

In transporting way-freight the narrow-gauge cars have still greater advantages as is shown by the following table:

GAUGE.	No. of cars to carry Shipment.	TONS.										
		1	2	3	4	5	6	7	8	9	10	11
		DEAD WEIGHTS.										
Br'd	1	18,500	9,250	6,166	4,625	3,700	3,083	2,642	2,312	2,055	1,850	.....
"	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,363
Narr.	1	8,000	4,000	2,666	2,000	1,600	1,333	1,142	1,000	.....	.....	.....
"	2	.....	.....	.....	.....	.....	.....	.....	.....	1,777	1,600	1,454
*	...	10,500	5,250	3,500	2,625	2,100	1,750	1,500	1,312	278	250	1,909

This table shows that if it is necessary to drop cars with 9 tons of freight, at a way-station—this being an amount which is one ton over a car load for the narrow guage, and which renders necessary the use of two cars at the utmost disadvantage—the dead weight is even then only 1,777 lbs. per ton, and still 278 lbs. less than the broad-gauge. As to wear and tear, if we assume that the repairs of machinery and rolling stock are in direct ratio to their cost, the reduction for the narrow-gauge would be about 50 per cent., which is the difference in the first cost. Narrow-gauge locomotives weigh from 6 to 18 tons, depending upon the nature of the service they have to perform. The following table gives the principal dimensions and weights of various patterns and sizes of narrow-gauge locomotives, together with the loads they will haul on a straight track in good condition:

*Difference in favor of narrow-guage.

DIMENSIONS, WEIGHTS AND LOADS OF NARROW-GAUGE LOCOMOTIVES.

Kind of Locomotive.	Cylinders.		Diameter of Driving Wheel.	Weight in Working Order.			Load in Gross, Cars and Lading.			
	Diameter.	Stroke.		Total.	On Drivers.	On each pair of Drivers.	On a Level.	On a 40 ft. grade.	On an 80 ft. grade.	On a 100 ft. grade.
Class 1. Four wheels, connected tank locomotive.	9	12	30	18,000	18,000	9,000	390	120	70	55
	9	16	36	22,000	22,000	11,000	490	150	85	70
	10	16	36 to 40	26,000	26,000	13,000	590	180	105	85
Class 2. Four wheels, connected with separate tender.	9	12	30	16,000	16,000	8,000	385	115	65	50
	9	16	36	20,000	20,000	10,000	480	140	75	60
	10	16	36 to 40	24,000	24,000	12,000	580	170	95	75
Class 3. Six wheels, connected tank locomotive.	10	16	36	28,000	28,000	9,333	615	185	105	85
	11	16	36	33,000	33,000	11,000	740	225	130	105
	12	16	36 to 40	38,000	38,000	12,666	860	265	150	125
Class 4. Six wheels, connected with separate tender.	10	16	36	25,000	25,000	8,333	505	175	95	75
	11	16	36	30,000	30,000	10,000	730	215	120	95
	12	16	36 to 40	35,000	35,000	11,666	850	255	140	115

As the weight on each wheel and the momentum with which the wheels strike irregularities in the track affect the "wear and tear," we give the following data for the two gauges:

WEIGHT ON WHEELS—THEIR MOMENTUM.

[Passenger trains—Speed 25 miles per hour.]

	Five Feet Gauge.		Three Feet Gauge.	
	Weight on single wheel Pounds.	Momentum. Pounds.	Weight on single wheel Pounds.	Momemtum. Pounds.
Engine driver	8,000	288,000	6,250	225,000
Engine truck	5,000	180,000	2,500	90,000
Tender	7,650	174,000	3,500	126,000
Baggage car	4,000	144,000	3,000	108,000
Passenger car	4,760	171,360	1,780	64,080

The ends of the rails are beaten to pieces, the surface abraded, the ties splintered, the fibre of the wood cut under the iron, weak joints rapidly made worse, so that each succeeding wheel falls with an increasing force upon the ends of the yielding rails by the tremendous forces developed by the passage of these enormous weights at high speed. The lightest broad-gauge coach weighs about 16 tons, or 32,000 lbs. empty, and hammers the rail joints with 4,000 lbs. on each wheel. When loaded and driven over the rails at 25 or 30 miles per hour, the weight of the blow is enormous and terribly destructive to the superstructure, crushing out the best rail in five or six years. The passenger car of a three-feet gauge would only hammer the rail with 1,500 lbs. per wheel. The same applies to locomotives. A 30-ton locomotive, and its loaded tender, weighing about 14 tons, or a total of 57 tons, will exert a pressure of nearly six tons on each driving wheel. When driven at a high speed, the strain upon the track is terribly destructive. The "Fairlie" engine, constructed for narrow-gauge lines, bears its whole load, including wood and water, on the driving

wheels, thus utilizing the whole weight in the work of hauling the train. Instead of an engine carrying 57 to 50 tons to obtain the power of 20 tons, we have an engine weighing 20 tons and no more; and this load distributed over eight wheels, with a pressure of 2 1-2 tons per wheel, instead of 6 tons, as with the broad-gauge. The action upon the rolling stock is the same as upon the track. The wheel receives a blow of precisely the same weight as that administered to the rail at a low joint, and the shock is transmitted to the axles except what is taken up by the springs and the yielding of the parts of the whole structure of the engine or car. The saving of dead weight is so much saved from the grand total of this destructive agency; and by the reduced weight upon each wheel, no single blow of such enormous forces can be given on the narrow gauge.

Can narrow-gauge locomotives be constructed of sufficient power and speed to answer the general requirements? They can, as daily experience testifies. The locomotives of the Denver and Rio Grande Railway, freight and passenger, are giving entire satisfaction both as to speed and power. By adopting the proper form of construction, the engines can have sufficient power to handle any number of cars that can be prudently and economically run together in one train, and such a train can be handled with as much safety as on the broad-gauge; while the proportion of dead weight being much less, the same number of train men will handle more tons of paying freight, when worked up to the same tonnage. There is no difficulty in making as fast time as the great majority of the broad-gauge roads make, which is all the public demands.

The first class narrow-gauge coaches on the Denver and Rio Grande Railway are 40 ft. long over all, 7 ft. wide inside, 7 ft. 6 in. high, with two 4-wheel trucks, wheels 24 in. in diameter, weight 12,000 lbs. and carry 36 passengers. The sills are only 27 in. above the rails, making the center of gravity very low; hence the cars ride exceedingly steady and with less lateral or oscillating motion than is usually observable upon the broad-

gauge. The seats are arranged, double on one side and single on the other, one-half the length of the car having the double seat on the right, and the other half having them on the left, so as to distribute the weight equally. The single seats are 19 in. wide or long; the double, 36 in.; the aisle 17 in. If found desirable the width of the car can be increased to 8 ft., making the single seat 22 in., the double, 39 in., and the aisle 23 in. These cars, finished in the best style, furnish every comfort of a first-class coach. Sleeping coaches with a single berth on each side, can be constructed so as to be as comfortable as those now in use.

The freight cars of the Denver and Rio Grande Railway carry 9 of the largest cattle in a car weighing less than 8,000 lbs., while the broad-gauge cars carry only 14 of the same class in a car weighing from 18,000 lbs. to 20,000 lbs. The stock cars have 4-wheeled trucks, are 24 feet long, the door being at the side, but near the end instead of the center, and on the opposite side of the other end. For heavy and valuable cattle, they have two gates in the car (which when not in use are folded back against the side of the car), which makes three rooms 6x8ft., into which they put three head of stock, each, giving a space of 2x8ft. to each head. The broad-gauge puts 14 head of the same cattle into a 28ft. car, which gives the Denver and Rio Grande and other narrow-gauge cars the same floor room that the broad-gauge cars, have and with much less dead weight.

COMPARATIVE DEAD WEIGHT IN THE TRANSPORTATION OF CATTLE BY THE TWO GAUGES.

Gauge.	Weight of cars in lbs.	No. cattle per car.	Weight of cattle in lbs.	Gross weight of loaded cars.	Total weight per head.
Broad	18,000	14	19,600	37,600	1,285
Narrow	8,000	9	12,600	20,600	888
Dead weight in favor of narrow gauge					397

A difference of 397 lbs. per head, 3,573 lbs. per car load of 9 head, and, in a train of 20 cars, 71,460 lbs. or 35 tons in favor of the narrow-gauge. As so many are not put together in the latter, the danger of the cattle getting down is much less, while they can be fed and attended to much better.

COMPARATIVE COST OF TRANSPORTATION.

The average cost of transporting freight by the broad-gauge may be estimated at 1 1-2 cents per ton per mile, and on the narrow-gauge one cent. Estimating the cotton crop of the south at 4,000,000 bales, transported on an average 200 miles, the narrow-gauge would effect a saving of $4,000,000 per annum to the producers; a sum sufficient to build 400 miles of narrow-gauge railway at $10,000 per mile. The East India Company, looking to the extension of the cotton culture in their territory, have projected 10,000 miles of narrow-gauge railway, and that, too, in a country far more densely populated than ours, and offering a large general business. They are, besides, changing their broad to narrow-gauge. Break of gauge is an evil, but not so great as generally supposed. The time of transferring freight need be very little, if any, greater than is now necessarily consumed in the inspection and repair of cars at intermediate points, which are sent over long lines. In Great Britain the cost of transferring freight is about 2 pence per ton. In Canada 5 cents per ton. The cost will be heaviest upon through freight, which has to be changed at each end of a line, at a cost of 5 cents per ton, or a charge of 10 cents per ton total. As the average cost of transporting freight by the broad-gauge is 1 1-2 cents, one ton transported 200 miles would cost $3.00. But, as is seen by the following table, there is a saving of 25 per cent. in actual working expenses. A saving of 25 per cent. on $3.00 would be 75 cents, so that an expense of 10 cents per ton may be incurred in transferring freight, and still leave a balance in favor of the narrow-gauge, or shipper, of 65 cents per ton, $6.50 per car load of 10 tons, or $162.50 for a train of 25 cars.

CLASSIFICATION OF EXPENSES.

	Percentage of whole operating expenses.	Percentage saved by Nar. Gauge.
MAINTENANCE OF ROADWAY—		
Repairs road-beds	.166	.055
Cost of iron for renewals	.129	.065
Repairs, building fences, etc.	.037	.....
Taxes	.038	.....
Repairs of machinery and cars	.20	.070
OPERATING—		
Office expenses, agencies and employes on trains and at stations	.123	.....
Fuel, oil and waste	.125	.041
Loss and damages to goods and persons	.....	.....
General superintendence, etc	.030	.....
Contingencies	.052	.017
Total	.....	.248

In Norway, railways of the 4 ft. 8½ in. and of the 3 ft. 6 in. gauges have been constructed by the same engineers, and worked by the same manager for the government, and the following is the result of six years' experience:

	Gauge, 4 ft. 8½in.	Gauge, 3 ft. 6 in.	Difference in favor of Narrow Gauge.
Cost of construction per mile	$26,343	$17,143	$9,200
Receipts per mile (alike)	27,600	27,600	.....
Maintenance per mile	7,173	6,555	608
Locomotive expenses per mile	9,426	5,760	3,666

Mr. Millington, Chief Engineer of the Memphis and Knoxville Railroad, has made a careful estimate of the comparative cost of building 30 miles of the track extending from Memphis to Macon, with 3 feet and 5 feet gauges. The surface of the country is undulating,—in places rolling and bro-

ken, but with no serious obstacle to the construction of a first-class road at the average cost per mile of Southern roads. No gradients steeper than 66 feet per mile, and this only for short distances. No curves less than 1,146 feet radius, and none of this radius on steeper grades than 46 feet per mile. Grading all earthwork and easy to handle. The average haul about 400 feet. One girder-bridge of three 50 feet spans. The piers, piling. In consequence of the soil being very liable to wash during heavy rains, piling is used in preference to trestling, for which safe foundations would in some places be difficult to obtain. Weight of rail, 30 lbs. per yard for narrow-gauge, and 60 lbs. for broad-gauge.

GAUGE, FIVE FEET.

COST OF ROADBED.

664	stations, clearing and grubbing, at $9.00 per station		$5,976 00	.....
461,150	cubic yards earth excavation, at 30 cents per cubic yard		138,345 00	.....
150	lineal feet girder bridge, $12.00 per lineal foot		1,800 00	.....
5,665	lineal feet piling and trestling, at $7.50 per lineal foot		42,412 50	.....
41,520	cubic feet timber, log culverts, 3½ cents per cubic foot		1,453 20	.....
36,950	cubic feet timber in cattle-guards, roads, etc, at 3 cents per cubic foot		1,108 50	.....
9,860	feet, board measure, plank in ditto, at 3 cents per foot, board measure		295 80	.....
	Laying 30 miles of track, at $500 per mile		15,000 00	.....
			$206,391 00	
79,200	cross-ties, at 40 cents each	$31,680 00	.....	.....
	Engineering, right of way, salaries, office expenses, stationery, incidentals..	10,000 00	.....	.....
			41,680 00	.....
				$248,071 00

COST OF SUPERSTRUCTURE.

3,168	tons of rails (60 lbs. per yard), at $90.00 per ton	$285,120 00	.....
12,000	joint fastenings, at $1.00 each	12,000 00	.....
165,000	pounds spikes, at 5 cents per pound	8,250 00	.....
			$305,370 00
	Total for roadbed and superstructure		$553,441 00

Cost per mile for road-bed	$8,269 00
Cost per mile for superstructure	10,179 00
Cost per mile for roadbed and superstructure	$18,448 00

THREE-FEET GAUGE.

COST OF ROADBED.

589	stations, clearing and grubbing, at $9.00 per station	$5,361 00	.....
244,200	cubic yards earth excavation, at 30 cts. per cubic yard	73,260 00	.....
150	lineal feet girder bridge, at $12 per lineal foot	1,800 00	.....
5,655	lineal feet piling and trestling at $6 per lineal foot	33,930 00	.....
29,580	cubic feet timber, in log culverts, at 33 cents per cubic foot	887 40	.....
23,400	cubic feet timber in cattle-yards and road-crossings at 3 cts per cubic foot	702 00	.....
6,020	feet, board measure, planks in ditto, at 3 cents per foot, board measure	198 00	.....
	laying thirty miles of track at $375 per mile	11,250 00	.....
		$127,329 00	
79,200	cross-ties at 30 cents each... $23,760	.....	.....
	engineering, right of way, salaries, office expenses, stationery and incidentals 10,000		
		33,760 00	.....
			$161,089 00

COST OE SUPERSTRUCTURE.

1,584	tons of rails (30 lbs per yard), at $95 per ton	$150,480 00	.....
10,500	joints fastenings at 80 cents each	8,400 00	.....
105,609	pounds spikes at 6 cents per lb	6,336 00	.....
			$165,216 00
	Total for roadbed and superstructure		$326,305 00

Cost per mile for road-bed	$5,369 63
Cost per mile for superstructure	5,507 20
Total cost per mile for road-bed and superstructure.	$10,876 83

RECAPITULATION.

Distance.	Gauge.	Cost of preparing road-bed for rails	Cost of superstructure.	Cost of road-bed and superstructure.	Cost per Mile.		
					Road-bed.	Superstructure.	Total.
M	F.						
30	5	$248,071 00	$305,370 00	$553,441 00	$8,269 00	$10,179 00	$18,448 00
30	3	161,089 00	165,216 00	326,305 00	5,369 63	5,507 20	10,876 83
*	..	$86,982 00	$140,154 00	$227,136 00	$2,899 37	$4,671 80	$7,571 17

Making a saving in favor of the narrow-gauge on the cost of preparing the road bed, 35 per cent.; on the cost of superstructure, 46 per cent.; on the roadbed and superstructure, 41 per cent. We have the following estimates of cost of two Canada roads, guage 3 ft. 6 in.:

TORONTO, GRAY AND BOUCE.

Western Junction to Orangeville, 41 *Miles.*

	Total.	Per mile.
Grading, fencing, ties, bridges and culverts	$196,595	$4,795
Rails and fastenings	181,015	4,415
Track-laying and ballasting	67,770	1,653
Station buildings	24,407	595
Right of way	24,600	600
Telegraph	1,640	40
Engineering	23,370	570
Commissions, officers, directors' fees, etc	15,469	377
Law expenses	3,936	96
Sundries	2,000	49
	$540,802	$13,190
Rolling stock	105,960	2,560
Total cost	$646,762	$15,750

* Difference in favor of narrow-gauge.

TORONTO AND NEPISSING.

Scarboro Junction to Uxbridge, 32 Miles.

	Total.	Per mile.
Grading, fencing, ties, bridges and culverts	$151,307	$4,725
Rails and fastenings	139,041	4,345
Track-laying and ballasting	46,696	1,460
Station building	15,012	470
Right of way	22,092	690
Telegraph	1,500	47
Engineering	14,110	441
Commissions, officers and directors' fees	10,292	321
Law expenses	936	30
Sundries	615	20
	$401,601	$12,549
Rolling stock	101,588	3,175
Total cost	$503,189	$15,724

By which we see that the Toronto, Gray and Bouce Railway has cost $13,190 per mile, exclusive of rolling-stock; and including rolling-stock $15,750 per mile. The earthwork averages 10,500 cubic yards per mile. The line is fenced throughout, at a cost of $800 per mile. The grubbing amounts to an average of one-half an acre per mile; the clearing to three acres per mile; slashing on each side of the railway to the entent of four acres per mile has also been done, the grubbing, clearing and slashing having together cost $140 per mile. The ties have cost an average of 25 cents or $500.

The Toronto and Nepissing Railway has cost $12,549 per mile, exclusive of rolling stock, or including rolling-stock, $15,724 per mile. The earth-work has averaged 9,750 cubic yards per mile. The line is fenced throughout at a cost of $700 per mile. The ties have cost $480 per mile on this section, and the grubbing, clearing and slashing, $140 per mile.

Upon the authority of Col. W. W. Nevin, who is connected with the management of the Mexico National Railway

Company, I give the following statistics in regard to Narrow-Gauge.

IN THE UNITED STATES.

Name.	Miles Built.	Total Length.
Denver and Rio Grande	156	870
Cairo and St. Louis	92	150
Utah Northern	70	160
Kansas Central	65	560
Arkansas Central	64	150
Colorado Central (N. G. Division)	42	237
North and South of Georgia	35	130
Montrose	27	27
Ripley	26	36
At Johnston (private)	25	25
Cherokee, Alabama	23	45
Iowa, Eastern	20	183
Milwaukee and Des Moines	20	380
American Fork (Utah)	18	22
Peoche (Nevada	18	18
Central Valley	12	12
East Broadtop	12	30
Mineral Range, Michigan	12½	100
Wasatch and Jordan Valley	12	16
Pittsburgh and Cattle Shannon	8	8
Bell's Gap	8½	40
Peekskill Valley	7	7
Summit County, Utah	8½	30
Tuskegee	5½	30
Louisville, Harrod's Creek and Westport	5	28
Painesville and Youngstown	12	65
Baltimore, Swan Lake and Lowsontown	6½	6½
Peachbottom	5	60
Bingham Cannon and Salt Lake	20	20
Ceredo Mineral, W. Va	12	20
Cheraw and Salisbury	11	80
Lawrence and Evergreen	5	5
Echo and Coalville, Utah	9	9
Natchez, Jackson and Columbus	6	260
Galena and Southern Wisconsin	30	150
	908½	3,889½
The following were to have completed additional mileage by January, 1874:		
Cairo and St. Louis	52	.....
Des Moines and Minnesota	17	.....
Parker's Landing and Kansas City	18	.....
	1,007½	

IN THE CANADAS.

Name.	Miles. built.	Total length
Toronto, Gray and Bouce	199	200
Toronto and Mississippi	87	218
New Brunswick	70	170
Prince Edward's Island	90	203
	446	791

The following list is given of

ROADS ACTUALLY UNDER CONSTRUCTION.

Name.	Under construction.	Total. length.
Florida, Memphis and Columbia	120	260
Lexington, Lake and Gulf	170	170
Wyandotte, Kansas City and Northwestern	50	250
Cairo and Tennessee River (under construction in Duck River Valley, Ala.)	75	100
South Branch (W. Va.)	26	51
Cheraw and Salisbury	15	80
Nashville and Vicksburg	26	470
Bambridge, Cuthbert and Columbus	20	140
California Central	150	465
Des Moines and Sioux City	20	180
Salt Lake, Sevier Valley and Pioche	25	300
Alameda, Oakland and Piedmont	60	60
St. Louis and Manchester	8½	30
Juan, San Pete and Sevier	10	75
Washington, St. Louis and Cincinnati	65	950
Greenville and Paint Rock	5	22
Stockton and Ione (California)	36	36
St. Louis and Western	100	315
Denver and Rio Grande ....miles graded.	50	.....
Utah Northern ....do....	90	.....
Arkansas Central ....do....	86	.....
North and South of Georgia ....do....	60	.....
Summit County (Utah) ....do....	3½	.....
Peachbottom ....do....	45	.....
Ceredo Mineral (W. Virginia) ....do....	6	.....
Natchez, Jackson and Columbus ....do....	14	.....

The following

PROJECTED ROADS

Are organized and more or less under way:

North Pacific Coast	250
Big Sandy Valley	137
People's Narrow Gauge, of Iowa	170
Minneapolis, Rochester and La Crescent	140
St. Louis and St. Charles	14
Holly Springs, Brownsville and Ohio (being graded)	..
Long Island Narrow Gauge	..
Toledo and Maumee	..
Northern and Southern Narrow Gauge, N. C.	..
St. Louis and Florissant	16
The South Park Railway, Col	260
Tennessee Central	..
Memphis and Raleigh	..

From which we see that the total length of projected narrow-gauge roads in the United States is 3,889 1-2 miles, and in the Canadas 791, making a total of 4,680 1-2. Of this there are completed 1,354 1-2 miles; 908 1-2 in the United States, and 446 in Canada.

Wherever the narrow-gauge has been adopted it has proven a success—in Norway, Sweden, Denmark, Russia, India, Great Britain, Canada, United States and other places. Costing about one-half as much as the broad-gauge, many sections of the country now waiting for railway facilities for development can afford to build them at once, and thus prepare a market for their produce. Their first cost being small, their operating expenses and maintenance light, they will prove paying investments in almost any part of this country. For the reasons enumerated, I would recommend the narrow-gauge of three feet for general adoption.

DEPARTMENT OF LETTERS.

ON SEVERAL POINTS IN THE PRONUNCIATION OF LATIN AND GREEK.

BY S. S. HALDEMAN,

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Modern facilities for travel have had the effect of bringing the people of different countries together to such an extent that an opinion has been developed in favor of pronouncing names and quotations in the native mode, in some cases even when they contain sounds which do not occur in English, and the study of philology is gradually showing that language is amenable to the laws of speech, and not to the conventionalities of spelling.

Loose views about "English analogies" have resulted in much false science. By a true English "analogy," that is, by a law of English speech, pure or hard *gay* cannot occur before "soft" *dzhee* or *jay;* in genuine English speech, therefore, there can be no lug-jer for *lugger*, no beg-jar for *beggar*, nor words like *exag-jerate* and *sug-jest.* When we introduce a foreign word which corresponds with an English syllable, it is consistent with analogy to preserve the sound, as the syllable *key* in *musquito* and *quinine* (kee-neen—which is by some supposed to have the initial syllable of *quiet*), *lee* in *Liebig* and *rin* in *rinderpest.* A Latin analogy appears in the initial of *wine*, *wind*, *wit*, *worm*, and a French one in *veal*, *vile*, *victual*, *vagrant*, and even in *vacuum*, whose initial we pronounce with *vee* and

not with Latin *way*. Some Latin words or parts of words occur in English, as *ŏbēy*, *core*, *marine*, *genteel*—which is an older word than *gentile*, having preserved the Latin vowel which *gentile* has lost.

Most of our grammarians being grammatolaters or letter-worshippers, who determine vowels by the eye and not by the ear, they have given currency to several important errors. They tell us that 'the vowel of *not* is long in *note*,' when in fact *naught* is the lengthened form of *not*, and it requires more time to pronounce *know* with its single consonant than *note* or *not* with two consonants, for *note* and *obey* have a short *o*, which is long in *owe*, *lo*, and *own*. The long vowel of *may* shortens in *mate*, which is neither *met* nor *mat*. *Feet* and *fit* are equally short, with distinct vowels, and the rare vowel of *fat*, which is unknown to normal German, French and Italian, has no relation to that of *far*, but is akin to that of *met*.

Overlooking such facts, some who reject the English pronunciation of Latin fall into the error of giving the vowels of *hat*, *hit*, *hot*, *hut*, as Latin and Greek sounds. An English scholar once objected to a speaker for saying λόγος, because he supposed the vowels to be pronounced long, but the speaker made them very short—as short as in *o-mit*. When a Latin or Greek vowel varies in length, it does not change in quality, that is, it does not become a different vowel. Independently of its final, *lōcūsta* must be pronounced like *lŏcŭs*, except that it must occupy twice the time in utterance, and the *ŏ* of *lŏcŭs* must be placed in *hŏnŏr*, *hŏmo* (genitive *hŏminis*,) chŏrus, Greek χορός, which rhymes with mŏrŏse (Latin mōrōsŭs.)

The erroneous assertion has been made that in syllables termed long by position, the quantity is short. Latin, like Italian and Arabic, has doubled consonants, as in *pēnna*, *stēlla*, in which each consonant must be pronounced as in *un-natural*, which gives length, whether the vowel is naturally short or long. The principal vowel is naturally long in *lūx*, *lūcĕo*, *lūcĭfĕr*, *lūnă; fĕrōx*, *fĕrōcĭtās; frīgĕo*, *frīxī*. The short

vowel of *vĕho* may continue short in *vēxī*, *vēcto*; but this is difficult to determine, because *ĕ*, of *rĕgo*, *rĕgĭmĕn* is long in *rēgālĭs*, *rēgīnă*, and perhaps in *rēx*. In Greek *ὤχρα* (ochre) we have length by nature and position, and in *ὄχλος* (a crowd) the syllable is lengthened by two continuous consonants.

Those who pronounce the first syllable of the Greek *υἱός* (son) like English *hwee*, convert *υ* into a consonant, instead of keeping it strictly to its vowel power of French or German ü, and subjecting the *ι* to modification, for as two vowels cannot make a single syllable, one (usually the latter) must become a liquid consonant of the lip or throat series. A German cannot pronounce such an English form as hwee-ós, although he can pronounce every letter of the Greek word, which in his alphabet is hüjós. To sap *hwee-os* instead of this, is like saying *why* for *high*.

The initial vowel of Greek and Latin diphthongs does not vary from its ordinary sound, so that if Latin *o* is German and English *o*, the dipthong œ is nearer to English *oi* in *going* than to that of *loiter*; and Greek *ει* (with *ε* of *end*) should not be confounded with *αι*. Greek *ου* became the Latin vowel u (in *fool*) at an early period, but it is properly a diphthong beginning with *o*, which shows the relation between *βοῦς* and the Latin genitive *bŏvĭs* where the middle consonant is English *w*. Compare the double forms *sīlvă and sīlŭă*, *mīlvŭs and mīlŭŭs*.

As the Latin angular letter v is now rounded when it stands for the vowel u (oo), and as the letter q (coo) was introduced to show the consonant nature of the next element, qv should be printed instead of qu, the power being that of English *kw*. Some words in the derived modern languages have lost the liquid sound, leaving such forms as French *qui*, Italian *chi*, and Spanish *quien*, which have led some to believe that the Romans said 'aca' for *aqva*, and 'cando' for *qvando*. Even granting that some Romans may have pronounced thus, the liquid must have had an existence in normal Latin, because

such originals as 'cando' could not have produced the Spanish words *cuando*, *cuantidad*, *cuarta*, *cuestion* (formerly '*question*'; nor could 'aca' have produced Italian *acqua*, Spanish *agua*, Rhætian *aua*, *ava*, and Wallachian *apĕ*.

In conclusion, an opinion may be given, that as *di*-phthong means *two* sounds, it is possible to separate such, as in *οἴω* and *δίω* (to suppose), and we find the monosyllable *κλείς* beside its cognate dissyllable *κλῆίς*. But if the power of *ει* or *οι* is that of *ι*, as in Ellenic (modern Greek), no division can be made, because a vowel cannot be separated into two sounds, and diæresis has not the power to "separate" the English word *be* into *by*, *boy*, or *bo-i*.

THE ETYMOLOGY OF "CHURCH."

BY J. B. FEULING, PH. D.

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It is commonly assumed that *κυριακόν* is the orignal of "Church," but not universally admitted. Before considering the etymology of our word, let us first note some of its forms in English and the more important cognate dialects. In O. E. we have *chirche*, *chireche*, *churiche*, chiric-(lond), etc.; in A. S. (Low German), *cyrice*, *cirice*, *circe*. The *a* of *cyriac*, which I remember of seeing, but where I saw it I cannot now recall, crept in to connect it with kyriakon. The O. H. G. form is *chirihha*, *chilihha*. It is probable that *chiriihha*=*chirjihha*, found in Isidor, arose for a similar reason as *cyriac*. The *Old Danish* or *Old Northern* form is *kirkia*, which was introduced along with the gospel by missionaries, especially from England, from the IX to the beginning of the XI century. The first impulse had been given by the Frieslander Liudger, and the real "Apostle of the North," Anskar, had acted as the head of a school at Corvey, in Westphalia, on the banks of the Weser, and preached among the natives before he set out for the Scandinavian kingdoms. Among the *Slavonian* races we should expect to find a word directly derived from the Greek, as the first lasting success was gained by Cyril and Methodius, who were monks of the Greek communion and in intercourse with Rome. In the documents referring to their missionary labours "*ecclesia*" alone occurs. But the Slavonian words for church (*Cyrkew*, *Cerkiew*, *etc.*), are evidently connected with the parent of *chirihha*, which indicates the far reaching influence of the Teutonic spirit. Lipsius was the first who rejected the derivation from *κυριακόν*: "Credo

et a circo kirck nostrum esse, quia veterum templa instar circi rotunda." He was followed by J. Grimm who, in his G. Gr., proposed likewise *circus* (circulus), which is found very early under the form of *chirih* and *chirch;* in his preface to E. Schulze's Goth. Glossar (p. XI), he proposed the Gothic *kelikn*=ἀνώγαιον, the upper floor of a house (πύργος), in which he sees the Alemannic *chilicha*=templum, "as the oldest churches were not without spires." The *kelikn*, he says, would be an allied word to the Albanian *κοὺλλε*, Lith. *Koras* or *Koryczia*, which come very near the Anglo-Saxon and Old High German words. But in the German Dictionary, edited by Hildebrand, Vol. V, he abandons these etymologies and returns to *κυριακόν*, still not without objections. First he mentions the change in the grammatical gender; but it has been shown that Latin (Greek) neutra become feminine, not only in the Romanic, but also in the Germanic dialects. Another, more important difficulty lies in the loss of *α*, which could not be accounted for. Still the difficulty of which the derivation from *κυριακόν* presents, is little compared with the difficulty of wanting historical probability. We must be able to answer, how did the Germanic nations receive the word, or how did it happen, that they agree in this one word with the Greek church, but differ from the Latin church, which held sway among them in all other respects? From Rome they ought to have received *ecclesia*, perhaps *basilica*, as the Latin nations: French, *église* (iglise, esglise); Prov., *gleisa;* Italian, *chiesa;* Spanish, *iglesia;* Port., *igreja;* only in Roumansch, *baselgia* and Wall., *biseric* i. e. basilica. But *chilihha*, *cyrice*, etc., must have been rooted so deeply among the Germanic nations, when they came under the influence of the Latin church-language, that it could no longer be supplanted by the word *ecclesia*. It must have become a national word, which, like the Germanic *Ostara*, could not be dispossessed by *pascha* of the Latin church. Now if we stop at the etymology of *church* as is generally adopted, Philology cannot inform us, how the

Germanic nations came into possession of this word, but Ecclesiastical History alone. Of the attempts to account for the introduction of "*church*," if derived from *κυριακόν*, I mention the most important. Cf. Grimm's German Dictionary, Vol. V., 791 seqq., and Smith's Bible Dict. I, 452.

Jacobson, in his Church History, is of the opinion that this word had been introduced into Germany by British missionaries, either by the Anglo-Saxon Winfrith, or by the missionaries who had come before him from Brittany, who were however *Celts*. The Anglo-Saxons never came in direct contact with the Greek church; only an indirect contact may have taken place through the Celts of Brittany, who must have received their first missionaries from Asia Minor or from Gaul, where the churches at Lugdunum and Vienna had been planted by missionaries from Asia Minor. But this theory is not supported by the fact, that the Celts themselves have only Latin words: Ir. *teampall*, *domhnach*; Kymr. *teml*; Gael. *eaglais*, *eglwys*, Bret *ilis*, *llis*, i. e. ecclesia. In the Kymr. law of the 10. century we find *ecluys*, Old Cornish, *eglos*.* The introduction of the word into Germany by Winfrith, as mentioned above, is impossible, since we find, before his appearance in Germany, names of places compounded with it, e. g. in Alsace (a. 718) *Chiricunvillare*, a. o. For similar names of places in England see Taylor's "Words and Places."

The Greek influence can have made its way only from the south, and a considerable time before the mastery of the Latin church. But Ecclesiastical History is silent about such a far reaching Greek influence. Still it might have come from the lower Danube, where some Goths had been brought to the knowledge of Christ by Greek missionaries from Constantinople, since the 3d century; or from the river Rhone, across the upper Rhine. The Bishop of Lyons, Irenaeus, a Greek of the

*Roman influence, however, had entered into England, even before the landing of Roman missionaries, for Ninias, the apostle of the southern Picts, had been educated at Rome, and died early in the fifth century.

2d century, speaks already of "*αἱ ἐν Γερμανίαις ἱδρυμέναι ἐκκλησίαι.*" Mark here the term *ἐκκλησίαι*, as also the fact that in Gothic we find only *aikklesjo* and *gudhus* (*ἱερόν*).

Max Müller's theory that our word "*church*" was brought "by the Christian missionaries and priests, from the time of St. Augustine's landing in 597 to the time of Alfred," remains unproved. The passage in which *Κυριακόν* is used in the sense of church, according to M. Müller, is found in the canon of the Sixth Council, which prescribes: "*ὅτι οὐ δεῖ ἐν τοῖς Κυριακοῖς, ἢ ἐν ταῖς ἐκκλησίαις τὰς λεγομένας ἀγαπὰς ποιεῖν.*" Zonaras, of the 12th century, in commenting on the passage, says that the name of *Κυριακόν* is frequently found in the sense of a church, although only this canon directly distinguishes *ἐκκλησία* and *Κυριακόν*, "but I think," he adds, that the *ἤ* is not there used disjunctively, but by way of explanation." See Wedgwood's Etymol. Dict. The fact, however, that in the canons of the first four councils *Κυριακόν* is never used, but *ἐκκλησία* (the same word occurs in all the other documents, both Greek and Latin, which I had the opportunity to consult), and that Modern Greek has no word for church derived from *Κυριακόν*, seems to indicate that *ἤ* in the passage quoted by M. Müller is used disjunctively. On considering again this passage of the 6th council, I think that *ἐν τοῖς Κυριακοῖς* refers to the Lord's Supper and *ἀγαπάς* to the entertainment in which the poorer members of the church partook, furnished by the richer members. This canon would prescribe, therefore, that such entertainments should not take place either in connection with the Lord's Supper, or in the church. I venture further to conclude, although I had not the opportunity to examine the passages where it is said to occur, that wherever in the Canons *Κυριακόν* (sc. *δεῖπνον*) is found, it refers to the Eucharist.

Trench ('On the Study of Words' p. 101) says: The passage most illustrative of the parentage of the word is from Walafrid Strabo, abbot of Reichenau 842–849, who writes

thus: "Sicut domus Dei Basilica, i. e., Regia a Rege, sic etiam Kyrica, i. e., Dominica, a Domino nuncapatur."* But this assertion of the 9th centuary does not prove more than the same assertion of the 19th century. In Fitzedward Hall's "Recent Exemplifications, etc." I noticed that he tried to derive 'church' from 'ecclesia'; but I could not procure his article to see how he has succeeded. Nor have I been able to consult the dictionaries of Du Cange and Weigand.

History tells us that Roman legions and colonists had come in contact with Teutonic nations both north and south, long before the Christian religion had made its way among them, at the time when they established themselves in Gaul, along the line of the Rhine and later in other parts of Germany, under Drusus and others. Wherever it was convenient, they founded military camps and colonies; and it is well known that the neighboring tribes were not always in a hostile contact, but came by way of trade, etc. into a peaceful intercourse with the Roman soldiery.† Many Teutonic barbarians entered the Roman service and whole tribes accepted Roman protection. The Roman fleet visited the shores of Slesvig and Iutland. The consequence was that Germanic words crept into the lingua vulgaris (a few of which were adopted into the lingua urbana), as Roman words into the language of the bar-

*Es ist bekannt, wie wenig sich die alten Geschichtschreiber sowohl als die Urkundensteller in die Rechtschreibung der Namen zu finden wussten, die sie bald nach der Aussprache des gemeinen Lebens auszudrücken, bald in mancherlei, ihrer Meinung nach lateinischen (griechischen) Formen einzuschmelzen suchten. Wenck, Hess. Landesgesch, I 670, Anm, a.

† Les Romains avaient tonjours été un peuple d'esprit pratique. Le pays barbare qúil n'avaient pu dompter par les armes, ils s'appliquèrent à l'exploiter au profit de leur commerce. Geffroy, Rome et les Barbares. (Paris 1874 p. 45.—Dès l'époque où la rive gauche était devenue romaine, les marchands et négociants de l'empire avaient pénétré dans ces nouveaux pays, et bientôt traversé le fleuve. Id. p. 257; cf. also pp. 262 and 348 sqq. and Tacitus' Annal., in regard to the jus commercii, established under Marbod.

barians; and principally such words which were most commonly used in their mutual intercourse or whose import was new to either of them. But which terms could have been more often used by the Roman invaders or be more novel to the barbarous nations, than those relating to the command of the legions, to the charge or oversight of the military and other works necessary for the establishment of colonies? Such terms were "*cura*," "*curatio*" rerum, frumenti, legionis armandae, operum publicorum, viarum, aquarum, etc. G. superioris Germaniae legiones *curabat*, Tacit. Annal. VI, 30. That the word "*cura*" or one of its congeners has been the parent of "*church*," we shall endeavor to show. If we adopt *cura*, the c, hh, etc. of the Germanic dialects would be excrescent consonants or formative elements (cf. O. H. G. chranih; Slav. zeravi, zoraw; L. grus; Gr. γέρανος), and the name of the English *kirby*-churchtown, as also the German *kirweih*, *kirmes*, (i. e. originally the mass celebrated on the anniversary of the consecration of a church), a. o. would remind us of *cura*, unless the prefix *kir* is the phonetic decay of *curatio*. It is well known that only an educated ear is able to catch a foreign word and its stress and to observe this stress in the pronunciation. Now the barbarian in mouthing over *curatio* threw the accent of the antepenult back on the stem-syllable.

This shifting of the accent we observe in all Latin words which were introduced into the Germanic dialects at such an early period. E. g., L. *cupella*, O. H. G. *chubili*, G. *Kübel*; L. *cellarium*, O. H. G. *chellari*, G. *Keller*; L. *coquina* (cokina), O. H. G. *chuhhina* G. *küche*, A. S. *cycene*, E. *kitchen*. In consequence of the changed accent there followed *Gravitation*, i. e. the tendency of sounds to accentual centers. It is seen in the lengthening of accented syllables, the lightening and final disappearance of unaccented syllables. According to this law of gravitation the *o* of curatio was dropped, from *i* developed *e*, as it generally does among the North European nations, *a* sunk into *e* and after passing through intermediate *i* fell out alto-

gether. Thus we arrive at *curite* (curte). The Anglo-Saxon *î* or *ŷ* corresponds to Old High German *î*, which develops from *œ* of Latin words, e, g. pîna=*pœna*. As *cura* appears under an older form *coira*, *cœra*, which *œ* (whose sound in Latin we do not know) easily passed into *u* or *i*; cf. *fœdus* and *fidus*; *mœnia* and *munire*; it is possible that in the lingua vulgaris the pronunciation of *cura* fluctuated between *cœra* and *cira*. Any one acquainted with the vowel scale in the dialects of a modern language will not be surprised at such a supposition. For the change of the dental *t* into the guttural *c* we would account by the shifting of one consonant to another of the same class, which was favored here by the initial *c* (assimilation). A similar assimilation we find in χόλικες for the older χολάδες; cf. also panca, πέμπε (πέντε), quinque, fimf. etc. This change has been explained physiologically and occurs quite frequently; it is probable that in the Roman folk speech *c* and *t* were hardly distinguished* (cf. Aeol. κῆνος and Dor. τῆνος=κεῖνος), so that the ear of the Teutonic barbarian was more liable to mistake the one for the other.†

The Anglo-Saxon guttural appears usually as *c* (rarely as *k*),

* See M. Müller, Science of Language, 2 Series, p. 182. Grimm, W. B. v, 5, K 6.

† Other words in which we find c (k) and t (d) interchanged, are: Wilperaht, Wilpert, Wilperc; O. H. G. hart, harc and harug; Tuisco, Tuisto; schlenkern, schlendern; schlank, slender; Hekenstal, Hetenstal; Schalkjar, Schaltjar; Mikwoch, Mitwoch; Schwäbisch-Augsburg. Woerterb. von Birlinger, (München 1864). In a dialect of Modern Greek we find a peculiar change from τ to κ in the nom. and acc. neuter, of ἐκεῖνος. See Geldart, Modern Greek, p. 121; (Oxford, 1870). In the *Cantilène de Sainte Eulalie* of the IX century, as also in the *Vie de Saint Léger* of the X cent., we find *veintre* for *veincre* (*vencre*)=*vaincre*. In the latter poem we find *cartres* (castres) Lat. *carceres*. "Le c de carcer parait plutôt s'être changé en 't par un simple adoucissement euphonique" (Dissimilation). G. Paris, *Romania*, Vol. I, p. 313. It seems to me that the forms *didrai* and *ditrai* of which G. Paris (Romania, Vol. I, p. 290) says: "Je ne sais pas comment expliquer ces formes"—arose from *dic'rai* by assimilation.

which through the influence of Norman French is aspirated in the Southern dialect: *chirche* for *cir* (*i*) *c*—*e*. To *c* (k) corresponds in Old High German *ch*, which appears usually as *hh* in the middle of a word: *chirihh*—*a*. If we remember that from about 200 A. D., words with *ti* began to be spelt with *ci*, it will be easy to derive the Teutonic *cyrice* and *chilihha* from *curacio*, on the condition of the vowel changes in consequence of the shifted accent, as above mentioned. See *A. Fuchs*, *Die Romanischen Sprachen* (Halle 1849), p. 304.

The reason why the Latin word *cura* (*curatio*) had found such an easy access into the Teutonic speech and held its ground so tenaciously, until it was appropriated by Christian missionaries, perhaps already in the second century, who followed in the wake of the Roman soldiers and merchants—may be found in the fact that it has a similar meaning as the Gothic *kara*, O. H. G. *chara*, A. S. *cearu*, *caru*, E. *care*, though Grimm's Law does not allow to connect the Teutonic words with the Latin *cura*. Compare with these words the A. S. *carc* *cark*, in which *c* is an excrescent consonant, as k in hear-ken, etc.

Those changes, through which we have accompanied our word, we may call its history anterior to the period, when it was taken into Christian usage. It had lived on in the mouth of the common people, which prepared it for casting it into the declensional mould of the Teutonic dialects. It was undoubtedly familiar to and perhaps permanently appropriated by *Columbanus* (590–615) who worked in Switzerland, in the neighborhood of Zürich, by his fellow-worker and countryman, *Gallus* (690–640) who, with a perfect knowledge of the native dialects, promoted the conversion of the Swiss and Swabians, and later by *Kilian* (650-689), the center of whose labors was at Würzburg, in Franconia. As these missionaries came from Ireland, it is probable, that the Gadhelic word *Kil* which we find in a large number of local names in Ireland and which is said to denote originally a hermit's "cell," and afterwards "church," may have caused the change of r into l in the

South German dialects: *chilihha chirihha*;—although we find this interchange in many other words of the South German dialects, in which we can not assume such an influence. The consonant l being a weakening of r, may not the Gadhelic Kil stand for kir, and kir be a reminiscence of the Roman *cur a*? but it remains to be proven, whether kil as prefix in Irish village—names points indeed to "local centers from which proceeded the evangelization of the half-savage Celts." As *kil* means also *inclosure* in general, may it not have entered into the naming of villages long before the appearance of Christianity in Ireland? And if it really had the distinct meaning of "church" in the 1,400 local names in Ireland, according to I. Taylor (Words and Places, p. 227), it seems very strange, that the Celtic dialects did not retain it as the common name of 'church,' as the Teutonic dialects.

The theoretical middle steps through which we have followed "church," of course have passed away without a trace of them being left; they were perhaps only momentarily taken, but surely unconsciously. Foreign words taken by the uneducated into a language obey apparently no rule; they seem to enter into a chrysalis state, till they emerge fully fashioned from the depth of the folkspeech and take their rank in the literary language, no further mutable. But the external or phonetic change of a word is frequently accompanied by an internal or ideal change. The spirit of Christianity filled our word with a nobler meaning. From the oversight or charge of worldly affairs, implying responsibility for safety and prosperity it passed to the charge and oversight of that which concerns mankind so much—*cura* or *curatio animarum*. Thus we easily perceive the later development of its meanings, to that of the edifice, for instance, in which the *cura animarum* took place.

In conclusion, it will be of interest to consider briefly the history of *cura* in the Romance languages, whose ideal development in these languages seems to support our etymology of

"church." We have seen above, the Latin *cura* is used both of military commands and of civil administration. From this meaning the French *cure* (Saintongeois, *chure;* Wallon, *Keure;*) passed into the meaning of *'charge ecclesiastique*, cure d'âme (Seelsorge). In Old French it is still found in the meaning of *soin, souci.* Then it passed into the meaning of the "house of the priest," but not of the "house of the Lord," for *ecclesia* had already been firmly established.*

In Low Latin we find *curatus*, (celui qui est chargé d'un soin, du soin des âmes), whence French, *curé;* Italian, *curato;* while the Spanish employs the abstract *cura.* D'Arnis' Lexicon ad Scriptores Mediæ et Infimae Latinitatis mentions, besides *curatus*, *curator*=custos ecclesiae; and also the following suggestive phrases: CURATA *ecclesia*, parochialis, cui præest curio; *curatum beneficium*, sacerdotale, ad quod pertinet cura animarum. Of special interest is the form *curita*=curatura, which exhibits the trace of a phonetic decay, as postulated above.

In the preceeding we have endeavored to follow the two fundamental rules of etymological research: 1. "No etymology is admissible which refuses to account for all the letters of the word it proposes to explain, without a single exception;

*In the documents of the Merovingian epoch we find *ecclesia* or *basilica* used for the sacred edifice, but never *templum.* Also *Monasterium* and *coenobium* signify *church*, while a monastery was called "casa Dei." From monasterium we have in A. S. *minster*, G. münster, in O. F. *mouster*, *mushter*, which were lost in Modern French. It is strange that the forms *mouster* and *iglise* or *esglise* which were brought to England by the Norman-French, and were employed in the middle of the XIII century (Cf. Romanz de un chivaler e de sa dame e de un clerk, ed. by P. Meyer, Romania, Vol. I), did not supplant the A. S. *cirice*, for we owe to the Normans most of the terms pertaining to the church. See R. M. Morris, Historical Outlines of English Accidence, p. 30. This shows, that the word from which developed *cirice*, must be older than the ecclesiastical terms which entered the Anglo-Saxon in the 6th century, so that the words of Robert of Gloucester apply to it: Ac lowe men holdeth to Engliss and to hor owe speche yute.

and 2, every etymology which assumes a change of letters ought to have in its favor at least one example of a change quite identical with that which it assumes." If thus the phonetic growth alone of our word out of the Latin *curatio* (cura), is more organic than out of the Greek *κυριακόν*, and therefore preferable,—it becomes still more so through historical probability and through the beauty of its import.

HISTORY OF THE SCIENCE OF HYDRAULICS.

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Although some of the fundamental principles of the science of hydraulics were discovered and applied by Archimedes, the progress of this science was almost imperceptible until about the fourteenth century. And this, notwithstanding we read that Rome in A. D. 98 was supplied with water by nine aqueducts, whose discharge was 27,000,000 cubic feet per day, and whose aggregate length was 250 miles. About the beginning of the fourteenth century, great damage was experienced by the overflowing of the mountain streams of Italy, which resulted in disastrous litigations, arising from the stringent laws enacted for the protection of property. This called the attention of practical and scientific men to the necessity of inventing some means of preventing these inundations and rendering the streams more navigable. This resulted in the invention of the canal lock, which was first applied to the canal between the Ticino and Milan, which is at the present day in a perfect state of preservation. From this date hydraulic engineering was ranked as a science, and has steadily progressed to the present time. The successive stages of this progress it is now proposed to follow.

Towards the last of the fifteenth, or the beginning of the sixteenth century, Leonardo da Vinci, one of the architects engaged upon the construction of the cathedral at Milan, first applied his invention of the mitre-sill gate to the lock above mentioned. Canals were now rapidly constructed throughout all parts of Italy. In 1628, Castelli first introduced the meth-

od of estimating the discharge of a river by the velocity of the water. In 1643, Torricelli discovered the general theory of hydraulics that neglecting resistances, the velocities of fluids in motion are in the sub-duplicate ratio of the pressures. He also argued that the acceleration of the currents of rivers was due to the slope of their surfaces, basing his conclusions upon the supposed analogy between spouting fluids and rivers. Pascal made valuable contributions to the science in his works published between 1646 and 1663. A dispute having arisen in 1665, among the inhabitants of the Chiana valley as to the disposition of the water of a certain stream, Rome and Florence assembled a scientific congress to report upon the best plan of accomplishing this task. Many theoretical essays upon river improvements were submitted, but these added very little to what was previously known upon the subject.

Near the close of the seventeenth century appeared the work of Mariotte and Guglielmini. These authors adopting the parabolic theory of rivers, of the celebrated Torricelli, perfected it. According to this theory the velocity of any particle of water in a river will be the same as that of a body falling from a state of rest through a distance equal to that of the particle below the plane of the surface of its source produced. As this theory is contrary to observation and was adopted by so many writers it shows how theoretical was the science at this period of its history. The principal writers upon it being philosophers whose lives were passed in inventing theories and deducing therefrom practical laws instead of making practical observations and building upon this foundation their theories.

Newton in his Principia, published in 1714, discusses the friction of fluids on solids and the discharge through orifices, and though some of his conclusions are erroneous his contributions to the science are valuable.

The Marquis Poleni first discovered that by adapting a small cylindrical tube to an orifice in a thin plate the discharge

could be increased. His work upon the discharge of fluids through orifices was published in 1718. Varignon in 1725 published his work on hydraulics in which he reduced the parabolic theory of rivers to algebraic formulæ.

M. Pitot, between the years 1730 and 1738, made a series of experiments upon the velocities at different depths by means of the tube which bears his name. These experiments proved the fallacy of the parabolic theory of flowing water. In 1732, were published the results of the experiments by Couplet upon the discharge of water-pipes at Versailles. At the same time appeared the works of many Italian writers, such as Grandi, Manfredi, Zendrini, Frisi, Zanotti, Gennette. In 1798 was published the work of Daniel Bernouilli, who applied the principle of living force to the motion of fluids, which forms one of the schools of hydraulics.

Between the years 1742 and 1752 appeared the works of John Bernouilli and d'Alembert, upon the theoretical science of hydraulics. Valuable theoretical papers upon the motion of fluids by the celebrated engineer, Lecchi, and by Euler, appeared between 1765 and 1771. Professor Michelotti of Turin, and the Abbé Bossuet of Paris, first established it as a fundamental principle, that formulae must be deduced from experiment and not from theory. The former conducted an extensive series of experiments under the patronage of the king of Sardinia, the results of which were published in 1774; the latter conducted a series of experiments under the patronage of the French government, the results of which were published from 1771 to 1778. Both of these furnish important data, particularly the latter, and have been of great value to succeeding writers in deducing constants and testing the accuracy of formulae. We consider that the origin of the modern school of hydraulics is due to the last two named authors. The works of the earlier writers are now of but little importance to the practical engineer.

In 1775, M. Chezy, an eminent French engineer, deduced

the first formula for mean velocity in terms of the slope and dimension of cross-section.

In 1782 was published a voluminous work of Belidor, Architecture Hydraulique, Paris. In 1874, M. l'Espinasse published in the Memoirs of the Academy of Science, at Toulouse, two papers on the expenditure of water through large orifices, and on the junction and separation of rivers.

In 1786 was published the celebrated work of M. Dubuat, which is still a standard authority in the science. He produced a formula which is applicable to most problems respecting the uniform motion of water. He fully illustrates its practical application and touches upon all the general questions of interest to the hydraulic engineer. Valuable works on hydraulics were published by Bernard in 1787, by Brünings in 1790, by Woltmam between the years 1791 and 1799. Fabre published a work on torrents in 1797. Venturi published a memoir in 1798, giving the result of a series of experiments upon the contraction of the fluid vein, in which he discusses, among other things, the effect of eddies in rivers and shows that they retard the current.

In 1800 Coulomb published a paper in which he enunciated the principle that the resistance arising from the friction between fluids and solids may be represented by a function consisting only of two terms, being the first and second powers of the velocity. This is called Coulomb's law. In 1801, M. Eytelweine published a large work on hydraulics, following the methods of Dubuat, which has been translated by Nicholson, and has received a very flattering notice from Dr. Young in the Journal of the Royal Institute. In 1803, M. Girard first applied the law of Coulomb to flowing water in open channels, producing a much more simple and practical formula than that of Dubuat. Some of his other articles, particularly those on canals are of special importance. M. de Prony published his first work on hydraulics between 1790 and 1796, his second work in 1802, and his third in 1804. These works

have placed him in the foremost rank of writers on this subject. He shows in his third volume, by discussing experiments, that the resistances of fluids in uniform motion may be represented, as indicated by Coulomb, by an expression involving only two terms, one containing the first, and the other the second, power of the mean velocity; but that these terms should be affected by independent coefficients, and not by a common one, as advocated by Coulomb and Girard. He then deduces the value of these coefficients for pipes and canals by employing two methods given by La Place in his Mécanique Céleste, and by a general equalization of disturbing causes; he gives a new formula of his own for obtaining the mean velocity, etc., from that of the surface.

He published an additional paper in 1825, giving methods of simplifying the application of his formulæ. In 1804, Lecreulx published his Recherches sur la Formation et l'Existence des Ruisseaux, Rivières et Torrents.

In 1808–9 appeared the work of Fúnk, a celebrated German scientist, upon hydraulic architecture. M. Krayenhoff published in 1835, his "Recuil des Observations Hydrauliques et Topographiques faites en Hollande," containing a full collection of tables of observations upon the hydrography and topography of Holland, a standard work of great value. He made detailed measurements of discharge, slope of surface, etc., determining the velocity by means of observing the time of transit past a base line of vertical poles reaching from the surface nearly to the bottom. In the Memoirs of the Academy of Berlin, 1814, 1815, appeared the celebrated articles of M. Eytelwein, giving new values to the constants in de Bouy's formulæ, etc. In 1816, Girard read before the French Academy his valuable work upon the Nile; his graphic representation of the daily gauges kept for the years 1799, 1800 and 1801, is the first diagram of the kind on record. In 1820 appeared Fúnk's second work on hydraulics. Escherde la Linth, in 1821, read a paper before the Helvetic Society of

Natural Sciences in Basle, upon the upper Rhine. By modification of Eytelwein's formulæ from a few measurements of surface velocity, he deduced by a daily gauge-record the annual discharge from 1809 to 1821 at Basle. De Prony published 1822, his noted work on the Pontine Marshes. In this year was published the result of a reconoissance of the Ohio and Mississippi rivers by General Bernard and Lieut. Colonel Totten, of the United States Engineers. This contains valuable information, especially upon the Ohio river.

In 1823 was published a valuable collection of Italian papers which made the collection complete from the fourteenth century. In 1824–26, M. Rancourt made his well-known experiments upon the Neva when frozen and when open. Mr. Poncelet published in 1828 his theory of permanent motion, that is, the permanent motion of water moving through a channel of variable area and slope. In the same year M. Belanger published his noted work on the same subject containing an original formula which gave more accurate results than any which had preceded it. In 1829, M. Genieys published a practical treatise upon water-works. In 1827 experiments were begun at Hetz upon a large scale to establish the principles of, and fix the constants in, the formulæ for water flowing through orifices. The results were published in 1842, by order of the French government and are known as the Poncelet and Lesbros experiments. In 1833 were published the results of observations upon the Rhine and its tributaries. This is the most important contribution to river improvement of modern times. The works used were both temporary and permanent. The temporary works were built for the purpose of inducing deposits of sediment, etc., which being of service but for a short period, were made of perishable materials. The permanent works consisted of levees and either solid revetments or breakwaters, to prevent the banks caving. These improvements were under of charge Defontaine. He advocates two general plans for improving the Rhine, first by closing all

chutes to confine the river to a single channel; and second, converting all straight lines to curved in the river's course. His reason for the latter plan is that in a bend the caving is limited to one bank, and can be more easily prevented than in a double line of defensive works on a straight line. The dimensions of the levees are far greater than those of the Mississippi. They are 10 feet thick at top, with a slope of one upon two towards the river and one upon one and a half toward the land. The height is calculated to be a foot and a half above the highest floods. Even the large levees are not considered sufficient. Strips of grass-land are left on both sides 6 1-2 feet wide on the exterior and 3 1-2 feet on the interior, measuring from the foot of the slope of the levee. On the outer edges of these strips are planted willows and poplars. To guard against filtration when the levees are more than 7 feet high a banquette is added. Here and there when the current of the river would be liable to act upon the levees, large and strong traverses at distances of 600 to 1000 feet apart are placed and protected, if need be, by fascines, to break the force of the current.

In 1834 appeared the first edition, and in 1840 the second edition of a general treatise on hydraulics by D'Aubuisson de Voisins. In 1835, M. Destrem published the result of a carefully conducted gauging of the Neva and its various branches, under his immediate supervision. In the same year appeared a historical sketch of the progress of hydraulics by Charles S. Storrow, Boston, giving the demonstrations and practical applications of various formulæ proposed by different writers on hydraulics. In 1836, Tredgold published Smeaton's experimental papers on the power of water and wind to turn mills; Venturi's experiments on the motion of fluids (1798); and Dr. Young's summary of practical hydraulics, chiefly from the German of Eytelwein, In 1840, M. Dausse obtained a premium for a paper upon the best methods of improving the navigation of the principal rivers of France. Between 1843

and 1853, the celebrated hydraulic engineer Lombardini, published a number of papers upon the hydraulic condition of the river Po, in which he demonstrates that levees have not elevated the bed of the river, although they have increased the height of floods by retaining between the banks the waters which before escaped through crevasses; and this height has been further increased by the more rapid flow caused by clearing the mountain sides of their forests. In 1841, M. Surell published a paper upon the torrents of the Alps, showing that forests exercise an important moderating effect, and advises their cultivation for that purpose. In 1843, M. de Buffon published his theoretical and practical treatise upon irrigation. He adopts de Prony's formula for the mean velocity with Eytelwein's co-efficients. He thinks the float, from its simplicity, is superior to all other instruments for measuring the velocity. M. Weisbach in his mechanics, published at Freiberg in 1846, treats very fully of hydraulics, for which task the special study of many years had peculiarly fitted him.

M. Surrell, in 1847, published an elaborate work upon the improvement of the river Rhone. In 1848 appeared Dupuit's work on hydraulics, which is a valuable contribution to the science. This same year was published a memoir by M. Baumgarten upon a portion of the Garonne, giving the various works used in the improvement and discussing their effects. He reports some very interesting experiments, among others that of measurements upon the transverse section of the water-surface at a nearly straight portion of the river (width about 600 feet), both when the water was rising and falling. When rising, at the rate of about 5 feet in twenty-four hours, with a maximum velocity of about 7 feet per second, he found the water in the middle to be about 0.4 of a foot above that on the right bank, and 0.1 above that on the left. When falling at the rate of about 8 feet in twenty-four hours, with a maximum velocity of about 7.5 feet per second, the water-surface was sensibly a plane, being at the right

bank a little less than 0.1 of a foot above its level at the opposite side of the river. In the proceedings of the American Association for the Advancement of science for 1848 and 1849, are valuable papers, which contain the results of experiments made at Natchez and Memphis upon the Mississippi river. The daily discharge at Memphis was determined by making a cross-section of the river, and subdividing it into three partial areas. The surface velocity in each of these areas was measured by anchoring the boat and using a chip and line. During calm weather the relative velocity near the bottom was also measured by comparing the velocity of a surface float and a double float whose lower portion, composed of a tin vessel, was sunk nearly to the bottom. The discharge was equal to the sum of the products of the partial areas by the average velocities in them. The temperature of the water at the bottom was found to be the same as at the surface. The velocity near the bottom was to that at the surface in the ratio of 268 to 300. The average downfall was 0.11 inches, and the average evaporation from the surface of the water of considerable depth, was 0.13 inches daily.

Mr. Ellet, in a memoir to the Smithsonian Institution in 1849, advocated the reservoir system for the improvement of the Ohio and other rivers. M. Boileau made a very extended series of hydraulic experiments by order of the French government between the years 1844 and 1854, which were published in the last mentioned year. It is a work of great value to the science.

In 1851 Mr. Ellet submitted a report to the War Department upon a survey made by him under its direction to determine the best method of preventing the overflows of the delta of the Mississippi. In the same year appeared a work on hydraulics by M. de Saint Venant, which contains much original and valuable matter. In 1855, Herman Haupt published a pamphlet advocating the improvement of the Ohio river, by a low dam and chute plan. Lombardini, in 1858,

published a memoir upon the recent inundations in France and the means of remedying the evils thereof. During this same year Dupuit in France, David Stevenson in England and Ellet in this country, made valuable contributions to the science.

The annual reports to the Chief Engineer of the Army furnish valuable information upon the improvement of rivers and harbors. Time at present will not permit my tracing farther the progress of this science, and I will merely add that the governments of all civilized nations have fully awakened to its importance, and by authorized experiments are daily aiding in its advancement.

THE NAMING OF AMERICA.

BY PROFESSOR J. D. BUTLER, LL. D.

The name America has been called a monument of ingratitude. It is said to be a misnomer, and worse than that, to owe its origin to fraud.

Our continent owes its name to Americus, the baptismal name of the Florentine navigator, Vesputius. Concerning him some specimens of popular opinion are these.

It is charged that, "after returning from Brazil, he made a chart in which he gave his name to that part of the main land. The date of his first voyage, as he gives it, is unquestionably false." So says Appleton's Cyclopedia. The whole narrative of that voyage Irving pronounces a "fabrication." Morse, father of the telegraphic inventor, says, "Americus had so insinuated that the glory of discovering the new world belonged to him, that the bold pretensions of a fortunate impostor robbed Columbus." Morse quotes the Scotch Robertson as authority. A thousand others have done likewise. Robertson accuses Americus "with premeditated usurpation of rights," etc. One of the most elaborate of British encyclopedias says, that "as the employment of Americus afforded him opportunity, so while drawing charts he distinguished the new discoveries by the name of America, as if it were Amerigo's land, so that the true discoverer, notwithstanding the complaints of the Spaniards, was defrauded of the honor that belonged to him." Delaplaine of Philadelphia — father of our Madisonian pioneer, charges Americus with imposing his name on the continent by stratagem, and says he gained his end by waiting till after the death of Columbus before putting forward his own pretensions.

Such, during three centuries, were the ideas prevalent regarding the naming of America.

Within the last generation, however, the researches of Humboldt in his *Examen critique* of the Geography of the Fifteenth Century, 1835–9; of Henry Harries in his *Bibliotheca Americana Vetustissima*, (New York, 1866); of Varnhagen in his monograph on *Amerigo Vespucci*, (Lima, 1865), and of others, have vindicated the character of Americus, demonstrated that he discovered more of America than any other man, and even rendered it probable that he set foot on this continent (June 17, 1497,) before either Columbus (August 1, 1498,) or Cabot (June 24, 1497,) while his name was bestowed on his discoveries not only without his instigation but without his knowledge.

It ought to be here said, in passing, that but for aids ministered by the Library of our State Historical Society, the following paper could not have been prepared in Wisconsin. There is no possibility of finding elsewhere, within the limits of our state, the documents to which every original investigator of my theme must betake himself.

The earliest charge against Americus, and that the mother of a myriad others,—*fons et origo malorum*,—originated twenty-one years after his death, and a thousand miles from his home. These circumstances stamp it with suspicion, and the more since no contemporary trace of similar aspersions can be detected in Spain, where he lived and labored.

It was in 1533, and in Nuremberg, that John Schöner remarked in a geography he issued then and there (*Opusculum Geographicum*), that "Americus sailing westward from Spain and coasting Asia, believed a region which belongs to *upper India* to be an island, which he appointed to be called by his own name."

Schöner's words were: "Americus Vesputius maritima loca Indiæ superioris, ex Hispaniis navigio ad occidentem perlustrans, eam partem quae superioris Indiæ est, credidit esse insu-

lam quam a suo nomine vocari instituit. (H. Harries, p. 304.) This passage affords no proof that Schöner *blamed* Americus for thus baptizing his finding with his own name. But there is no doubt that he did. Yet the first name which Schöner himself gave to the southern half of our continent on a globe he had made thirteen years before, and which we may see today in the city library at Nuremberg, is *America.* Besides, eighteen years before,—or in 1515, the same Schöner had published a geography in which we read, "America or Amerigen a *novus mundus*,—and fourth part of the globe, named after its discoverer Americus Vesputius, a man of sagacious mind, who found it in the year 1497." (H. Harries, p. 142.) As Schöner subsequently censured Americus, he must have changed his mind after 1515. It was after that time perhaps, that he first learned about the abuse of Columbus by Spaniards, and indignant at his wrongs naturally attributed the defrauding him of fame to the man who had gained most by that fraud. Yet the truth is, there is no proof that Americus ever gave his own name either on maps or otherwise to any portion of his findings,—though most other voyagers in all ages have thus perpetuated their fame.

The slur cast on Americus by Schöner was repeated and exaggerated, especially by Las Casas in his *Historia de las Indias*, a work not completed for forty-seven years after the death of Americus, till it reached the pitch indicated at the commencement of this article.

But no map with the name "America" on it of an earlier date than 1520, is known to exist, or to have ever existed any where. This first map appeared in Vienna, and long before any bearing the name America was issued in Spain, although its own date was eight years after the death of Americus. If any suggestions of his led to its issue, they must have been those fabulous, or at least thaumaturgic, "poisons given to work a long while after."

But the maker of this Vienna map had no thought of doing

injustice to Columbus. It is true he printed "America" in capitals on the southerly portion of the new found region which extends no further north than the equator, but he intended to call only a portion of that region by that name, for beneath the word America the word *province*, "Provincia," is subjoined. America, as then and thus designated, was a smaller part of the West Indies than the West Indies now are of America.

Thus much of honor may have been deserved by Americus, who possibly first discovered the American main land, and at all events was the first explorer of more of it than even Columbus.

Moreover, on the Vienna map, above the name America so that it may well apply to the north shore of South America and the West Indies, we read this epigraph: "In the year 1497 this land with the islands adjacent was discovered by Columbus, a Genoese by order of the King of Castile."

The original text is, Anno, 1497, hæc terra cum adjacentibus insulis inventa est per Columbum, Januensem ex mandato regis Castellae. AMERICA, provincia.

On this map, as on all before it and on legions afterward, the two portions of America are widely sea-severed. The truth is they were long regarded by no means as Siamese twins, but as belonging to different continents.

Men find what they seek. Columbus voyaged for India, thought his first landing was there, and forced his crew to swear they thought so too by threatening to cut out their tongues. (H. Stevens, "Historical and Geographical Notes.") Like too many others, he forgot that voting asses to be horses never made long ears short.

Columbus called his finding the main land or islands of India beyond the Ganges (*Insulæ Indiæ supra Gangem.*) Manifold memorials of his mistake we see to this day. Witness our aborigines from pole to pole called "Indians;" witness the archipelago between the Americas now as in the beginning,

"West Indies;" witness *Las Indias*, the Spanish official name including even now all our continent; witness the words, "King of the Indies," *Indiarum rex*, stamped on every Spanish dollar we, ever saw.

Show Agassiz one bone, and he would reconstruct any animal; so when Columbus beheld one corner of trans-Gangetic India, that is of Eastern Asia, he could map the whole of it, for that eastern coast line was known to him from the relations of overland travelers. The configuration of that Asiatic line is not without resemblances to that of eastern North America. Hence the delusion lasted longer, and each new finding pieced out the Asiatic map, like a new patch sewed on an old garment. A quarter of a century after the death of Columbus, the prince of German geographers still maintained that Mexico conquered by Cortez ten years before, was the Chinese city Quinsay, so excessively extolled by Marco Polo. So Humboldt tells us in his Cosmos.

Syllacius, the first Italian who described the first voyage of Columbus, in his "*opusculum de insulis nuper repertis*," assured both that that navigator had pushed through to trans-Gangetic India, and perhaps also satisfied that a ship sailing westward must slip off from the world, represents Columbus as circumnavigating Africa. *Ultra Æquatoris metas, usque ad Arabiae beatas insulas.* Persistence in mistaking North America for Asia was one among countless illustrations that false knowledge is worse than ignorance; a truth so well understood by Isocrates, who always exacted double fees from students who came from another teacher, one for unteaching as well as one for teaching.

Among the results of Columbus's error, the Pacific was called the *South* Sea, being supposed to lie almost altogether south of the equator, and the better half of the western hemisphere was reckoned by many an appendix of Asia, even until Behring passed through his Straits only four years before the birth of George Washington.

Faith in the connection of North America with Asia outlived many a proof to the contrary. It was scarcely less credulous than the "hard shell" citizens of the Egyptian section of Illinois, who are reported to continue deaf to all reports concerning the death of "Old Hickory," and so still cast their Presidential votes for Jackson.

But this Asiatic mania, if I may so call it, was much less lasting in reference to *South* than to North America. That portion of our hemisphere in fact approaches the old world nearer than the northern half of it does, and its actual distance from Africa was under-rated. On some early maps its easternmost cape was set down as no more than ten degrees west of the Cape Verd group. Its outline was also ascertained by nautical survey, while the corresponding coast of North America was still mapped after the model of Asia.

As neither the position nor the coast-line of South America had anything in common with European ideas respecting Asia or the globe southeast of it, it was at once regarded as a discovery veritably new. Accordingly, while the West Indies were viewed as only an extension of the Canaries, and Columbus was thought to have discovered only some other islands further toward the Indies of the East (*Insulas alias incognitas versus Indos*), and North America was drawn after an Asiatic pattern, or held at most for a thin barrier on the road to Asia and cut through by straits if not by seas,—men were already satisfied that South America was nothing less than a continent, and so sought for it a name. No man did more to make South America thus known to the old world than Americus. He was first to trace its shore line through fifty degrees of latitude even down to Patagonia.

"As early as 1501, Vespuccius proposed to double the extremity of the Southern Hemisphere." H. Harries, p. 226. Would it have been surprising if he had appeared in the earliest maps and books honored with a name in the world of wonder he had revealed? But he does not?

The oldest map containing engraved delineations of the new countries was published at Rome in 1508. On this we see the southern portion of our hemisphere which stretches through more than fifty degrees of latitude and sixty of longitude, inscribed, "Land of the *Holy Cross*, or New World." No America was yet dreamed of. Says Roselly de Lorgues, "The discovery having been made under the auspices of the cross, and for the triumph of the cross, the new land was usually designated on maps by the sign and name of the cross. (*Terra sanctae Crucis.*") Nor yet was there any other western continent in existence, according to the notions of the Roman mapmaker. His nearest land west of Cuba is Bengal. North of it the nearest land is that explored by the Cabots, which is mapped as a part of Asia, and conterminous with Gog and Magog. This map (11½x16 inches) was drawn by Ruysch, a German navigator, who is believed to have sailed with Americus.

It was forbidden to infringe its copyright or that of the geography which contained it, on pain of excommunication, but the price of the work was to be fixed by the Pope's librarian. Such a defense of the public from booksellers, and of authors from pirates is now, alas! one of the Lost Arts.

Humboldt arguing that Americus never knew that he had discovered a continent, holds that the words *Mundus Novus* (new world), in the fifteenth century, meant no more than any region new found, no matter though of small extent. Admitting the phrase to have been often thus used, it clearly was not as to the case in hand. The title of the first German edition (1505) of the third voyage of Americus is, "Concerning a new found region which may well be named a world." *Von der neu gefundenen Region die wohl eine Welt genennt mag werden.* Again the Mundus Novus on Ruysch's Roman map was well-nigh as extensive as we now know South America to be, and larger than Europe. But this map appeared four years before the death of Americus. Can we believe that he

himself knew less concerning the greatness of his own discoveries than was manifest on maps to all the world?

It is further worth notice that while the words *mundus novus* head the very first publication of the voyages of Americus, they never occur in the title of any one among the twenty-one works which were issued in the fifteenth century in relation to Columbus.

One reason may be that the islands—or at least the main land which Columbus brought to light needed in his opinion no name. According to his foregone conclusion they had been named already with appellations time-honored and in part sacred.

A principal reason then why our continent does not bear the name of Columbus, was that he and his contemporaries supposed there was no continent in existence which still remained without a name. Bombastes cut off only the hand of his slain enemy, because the head had been cut off already. Janus was never struck on the back of the head because he was all face, and time cannot be seized by the hind-lock for he is bald behind.

The first landing of Columbus on the American main was at the mouth of the Orinoco. He thought it the paradisaical Gihon. He died assured that he had there bathed in one of the rivers of Eden. According to his faith, "the airs of Paradise did fan its shores, and angels officed all." Small thanks would he have rendered anyone who had proved that his landing was not in Paradisaical Asia, but that it was of the earth earthy. His celestial dream he would have scorned to exchange for stamping his name on any continent. If forced to give up his beau ideal for a continental reality, his must have been the feelings of Lessing's hero in Nathan the Wise, who at the denouement found out that the lady whom he had adored with the love of forty thousand brothers, and who loved him as much, was after all only his own sister.

Should a less sentimental image be demanded, Columbus, if

disenchanted of his golden delusion, may be compared to a Californian pioneer bringing to the mint a load of glittering specimens from far off *placers*, and there convinced that they were one and all iron pyrites,—fool's gold and nothing more.

Columbus fancying America to be Asia lay under a mistake analogous to that of the Northmen in the tenth century. They sought no collective name for their great discovery, because they were convinced the America they had found was no more than an outlying fragment of Europe.

But how was greatness thrust upon Americus? How did his name, at first too plebeian to appear on title-pages, or to indicate a cape or bay, make its way into books and maps, and, supplanting all other appellations of the New World, gain a glory eclipsing whatever is reflected from all such names as New Spain, New England, New France, etc.?

Americus wrote several private letters, about his voyages, to friends in Italy and France, perhaps in 1502, but made no claims to give his name to any locality. These accounts of his discoveries were soon published, and were sometimes headed with his name, as *Nouo Mondo da Alberico Vesputio, Milan* 1508. More commonly their titles were complimentary to some sovereign, for that servility was then ubiquitous, which, to-day, in British army bulletins forbids naming any non-commissioned officer, even though a victory should be altogether due to him.

Thus the title-page of the earliest German edition of the letters of Americus (1509) is: "This little book relates how the two most illustrious Lords, Ferdinand King of Castile, and Emanuel King of Portugal, have searched through the vast seas,—discovered many islands, and a new world," etc. (Dies Büchlein saget wie die zwei durchlüchtigsten Herren Fernandus, K. zü Castilien und Herr Emanuel, K. zu Portugal haben das weyte mör erzüchet und funden vil Insulen, und ein Neüwe welt von wilden nackenden Leüten, vormals un bekannt.)

Another edition in Latin, was entitled, "concerning the Antarctic region formerly discovered by the King of Portugal. (*De ora antarctica per regem Portugalliæ pridem inventa.*) The earliest Italian edition was styled, "All the navigations of the King of Spain." (*Libretto de tutta le Navigazione del Re di Spagna Isole trovate novamente per el Re di Spagna*, 1495.) That monarch voyaged as easily as Solomon built the temple without lifting a finger, and no one has profited more by the law-maxim: *quod facit per alium facit per se.*

Perhaps it was his wife who, accustomed to do all drudgery by proxy, when urged by her confessor to do penance, said: "O yes, I will. I will make my maids of honor fast all through Lent!"

In many editions the motto was:

> "Cum Deus astra regat et terræ climata Cæsar,
> Nec tellus nec iis sidera majus habent."

> As God in heaven, so kings on earth bear sway;
> Above, below, no greater names than they.

The voyages of Americus were published separately many times, but, so far as can be ascertained, never together till the year 1507, and then in Lorraine at Saint-Díe. A professor in the gymnasium there, born in the neighboring Freiburg, was then publishing a Latin cosmography. While thus engaged, he fell in with the letters of Americus in French, translated them into Latin, dedicated them to René the local potentate, and added them to his other geographical chapters. His work was entitled, "*Cosmographiæ introductio.* * * * Insuper, quatuor Americi Vespucii navigationes."

On the title-page he mentioned this addition as "things unknown to Ptolemy and discovered by moderns." The professor's name was Waldzeemüller. After the fashion of his time he latinograecised it as Hylacomylus. In a note treating of the progress of discovery in the old continents, he adds: "but now another fourth part has been found by Americus, as

will be seen in the sequel. I see not why any one can rightfully forbid it to be called Amerige, or *America* as if the land of Americus after Americus, its discoverer, a man of sagacious mind, since both Europe and Asia have derived their names from women." So long ago were men fearful that women were getting more than their rights! In the margin of this note he printed the word *America.*

The exact words of the St. Die cosmographer are as follows:

"Nunc vero et hæ partes sunt latius lustratæ, et alia quarta pars per Americum Vesputium (ut in sequentibus audietur) inventa est, quam non video cur quis jure vetet ab Americo inventore, sagacis ingenii viro, Amerigen, quasi Americi terram, sive Americam dicendam: cum et Europa et Asia a mulieribus sua sortitæ sint nomina. Ejus situm et gentium mores et binis Americi navigationibus quæ sequuntur liquide intelligi dant."

This suggestion, according to our best knowledge, was the first ever made for giving honor to Americus and a collective name to his findings. It was published in 1507, on the 25th of April, which is accordingly the birth-day of the American name. But it never has been pretended that Americus knew Hylacomylus or could by possibility have incited him to bring forward his name.

It is not to be forgotten that the name America was thus proposed in 1507. This date refutes and renders ridiculous the pretense that Americus first foisted the name into maps when he was head of the Spanish cartological bureau, for he was not appointed to that position till a year afterward. Could he be guilty of a sin that was committed before he was born? No more than he could be guilty of Adam's sin. No more than a preacher can be called to account for his hearers' naps if they begin before he stands up for sermonizing.

Besides, as already stated, the earliest map on which the word *America* is inscribed, was made eight years after the death of Americus, and that name was introduced on Spanish maps later than any where else.

If any further vindication of Americus from the stain of stealing the laurels of Columbus could be needed we should see it in the fact that Columbus, to the very close of his life and his son after him, though very jealous for his father's glory, remained the fast friends of Americus. The charges of Las Casas, Humboldt considers refuted by the life-long friendship of the Columbus family with Americus. He also remarks that those charges are very mild near the beginning of his book, which was written soon after the death of Americus, but very harsh near the end of it which was written thirty years afterward. We may, therefore, appeal from Philip drunk to Philip sober—from Las Casas in his dotage to Las Casas in his best years.

Again, Cuba was believed to be the continent till after the death of Columbus, and he discovered that island in 1492. Americus sharing in this belief had no motive to date his first voyage 1497, unless it then took place. Why forge and falsify only for the name of discovering what, as was firmly believed, had already been five years discovered?

It was once my fortune to visit Freiburg—the native town of the namer of America. My journey thither in 1868 was repaid by its mountain scenery, its streets irrigated with living water after the manner of Salt Lake,—its cathedral unsurpassed in Germany till Strasburg was captured, and its associations with the inventor of gunpowder. But I was not then aware that it had given birth to the god-father of our western hemisphere. Had I been, its charms would for me have been tenfold. I also passed near Saint Díe where the name "America" was first printed, and perhaps first written. Had this fact been known to me how gladly would I have turned aside to gaze upon that cradle of our name. However small to the eye it would have been great to the mind. Still greater would have been my interest in it, had I not been ignorant that a head-master of the school there, Pierre D'Ailly, had written the picture of the world—*Imago mundi*, which stimulated

Columbus to his great voyage, and which is still to be seen in Seville with marginalia penned by the hand of Columbus himself. Americans will ere long pilgrim to Saint Díe, as the mother of their name, and so the source of a stream flowing further than the Mississippi, yes from pole to pole.

From the peaks of the Vosges, towering above the college of Hylacomylus, you can almost espy Strasburg, which claims the invention of printing, Freiburg where gunpowder was first compounded in Christendom, and Spires where Protestantism first assumed its name.

The new name for the new continent, proposed by Hylacomylus in 1507, was employed about five years after by Vadianus of Vienna, who indeed, until recent researches, was mistaken for its author. But three years sooner, or in 1509, it was adopted by an anonymous writer, who then published, in the neighboring Strasburg, his "*Globus Mundi*, or a description of the world as a round globe, whereby every man, even if he do not know much, can see with his own eyes that there are antipodes whose feet are opposite ours, together with many other things concerning the fourth part of the earth recently discovered by Americus."

Here, in this title, is one secret of the special importance attached to discoveries in *South* America, and hence to the exploits of Americus. His logic of facts rooted up two dogmas which had been viewed as essential to orthodoxy, one that there could not be antipodes, and the other that the equatorial zone was too hot to be inhabited. A commentator on Albertus Magnus soon detecting in him the same heretical taint, exclaimed in 1514, as if at the fulfillment of prophecy. "Lo! Albertus, two centuries ago, conceived that the earth might be inhabited beyond the equator, as Americus has found and described it"—things not in heaven and on earth but *under* the earth.

Interest in occidental exploration turned mainly southward for another reason, namely, that the first adventurers to the

West Indies and northward, reported much codfish, but no gold. Where the carcase is there the eagles gather. *Ubi mel, ibi apes.*

Onward from 1511 the name America appears in most geographies, and from 1520 in most maps But it long denoted no more than a portion of our southern hemisphere which was itself up to the year 1548 reckoned rather an island in the West Indies than a continent. The earliest known MS. map bearing the name America, is supposed to date from 1514. It was drawn by Leonardo da Vinci, and is among the treasures of the British museum. (R. H. Major, p. 388.) The extension of the name is worth tracing, yet not easy to trace.

On the Nuremberg globe of 1520 the southern part of the new continent is inscribed, *America vel Brasilia sive papagalli terra*, and the name for some decades after seems no more than commensurate with Brazil.

The name "America" in English cannot be traced back of 1520, and then it appears in an anonymous work "touching dyvers straunge regyons and the new found landys." It is thus introduced:

> "But this new lands founde lately
> Been called America by cause only
> Americus dyd first them fynde."

A year or two later was issued the first English book descriptive of this America. In this book the new region is spelled "Armenica." A century later Lord Bacon (vol. xiii. p. 196), speaks of "Mexico, Peru, Chili and other parts of *the West Indies.*"

The Landshut cosmography of 1524 calls America *now* a fourth part of the world—but adds that it is an island. "*Quoniam mari undique clauditur insula merito appellatur.*"

Copernicus, in 1543, writes that his theory was confirmed anew by taking into account the islands brought to light in his time, and especially America, which, owing to its magnitude still unascertained, men thought to be another world, *alter*

orbis terrarum. The great astronomer was before his age in geography also. So potent is a name that men still called geographies "Ptolemies," as we now call a dictionary Webster, though so metamorphosed that Webster would not recognize it. But the Ptolemy of 1540, only three years before the death of Copernicus, inscribes the map of the western hemisphere *Novæ Insulæ*, and its southern portion *Insula Atlantica quam vocant Brasilii et Americam.* In the Ptolemy two years later there is still no collective name for the north half of our continent, but a strait runs through it labeled *per hoc fretum iter patet ad Molucas.*

The rapids at Montreal were named La Chine (China) because the pioneers there thought they could ascend the St. Lawrence even into the Celestial Empire.

Nor were these Frenchmen so far wrong as were their more learned compatriots, for in "the Mirror of the World," issued at Lyons in 1546, three years after the death of Copernicus, we read: "Since Ptolemy no land called a continent has been discovered except one called America, about which we are not well assured, and several islands. As to America (which the writer also calls *L'Améque*,) I place little reliance on those who have been there, but speak of it so obscurely that one cannot guess what their dreams mean." Two years before, the Brazil map is inscribed *America seu Insula Brazilii.* The Antwerp cosmography of 1545 inscribes the map of the Western World on the southern part *America*, and on the northern, which is a narrow, elongated prolongation, *Baccalearum*, a word which means land of cod fish.

At length, in the Venice Ptolemy of 1548, forty-seven years after the discovery of Brazil, the southern half of the New World is mapped as a continent. *A partir de* 1548 *toutes les cartes que j'ai examinées représentent l'Amérique meridionale comme un continent.* So says Santarem, but his meaning is not clear, for he seems also to say that the map of South America is inscribed *Castill del Oro*, Golden Castile.

The new name America, having mastered the Southern, that is the largest, richest and best known half of the Western world, naturally spread over its outlying peninsulas, and the Northern portion was still either viewed as nothing more than one of them, or most of it was deemed more likely to be joined to Asia than to South America.

At some date, however, between 1548 and 1570, North America had also grown in men's minds to the dimensions of a continent, or at least to half that size, for on a map of 1570, the entire new world is inscribed *America.* This map of 1570 is the most ancient of all the goodly number in the library of our Wisconsin Historical Society. Its imprint is Antwerp. This map of the new world is inscribed near the Arctic circle, *America*, sive *India Nova.* The northern and southern portions are described as the northern and southern peninsulas, but neither of them is inscribed with any general name. It is added that the southern peninsula was called Terra Firma by Spaniards.

This map also shows a southern continent encircling the whole globe and at certain points almost touching the equator.

There is a wide channel from Baffin's Bay to the Pacific, although our portion of the northern peninsula stretches so far westward that its western shore is almost in sight of Japan.

When the name America was extended from pole to pole it lost its hold on Brazil, and it would seem for a time on the two grand divisions of the New World.

In Heylin's "Cosmographie," long in great repute, published in 1652, we read that "the fourth and last part of the world is called by some and most aptly the New World, but the most usual and yet somewhat the more improper name is America." "The whole is naturally divided into two great peninsulas, whereof that towards the north is called Mexicana, and that towards the south hath the name Peruana." On Heylin's map, however, the northern peninsula is inscribed "America Mexicana," the southern "Peruana America."

One question remains, and that too important to be now considered.

It is whether Americus really landed on the American main before Columbus and Cabot. Varnhagen claims that he did, and so that America is no misnomer after all.

He must have so landed if his date is correct, and Humboldt has demonstrated that his voyages are no where willfully falsified.

But however this may be, thus much seems clear, that Americus next to Columbus best deserved to have the New World named for him, that he never sought that honor by any means fair or foul, that the name originated without his knowledge, never appeared on a map until after his death, and then was long confined to a region smaller than that he had himself discovered.

It is pleasant to see clouds of suspicion rolled away from any character. Thereafter we think better of our race, and learn to believe Satan himself not so black as he is painted. What a good time was that when men ceased to burn geometries, on perceiving that the sign plus might not be popish, and that circles might not be conjurer's rings. It was a still better day when men saw a sovereign die and yet suspected neither poison nor foul play. It is especially pleasant to be assured that the American name which is our own, and which will be in the mouths of millions forever, is neither a monument of ingratitude, nor yet owes its origin to fraud. The word America, according to etymologists, means *rich in work.* May the American continent, in all its parts, forever deserve its name!

THE RURAL CLASSES OF ENGLAND IN THE THIRTEENTH CENTURY.

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At the last annual meeting of the Academy, I had the honor to read a paper upon the rural population of England in the eleventh century, a part of which has been printed in the Transactions of the Academy. I propose, to-day, to follow up the line of inquiry there suggested, and examine the changes in the social relations of the English peasantry during the two centuries that followed. I take two centuries rather than one, simply for the reason that the materials within my reach for the twelfth century are so meagre as, by themselves, to afford no certain results; while for the thirteenth century the materials are relatively abundant and instructive. On the other hand, I go down no later than the thirteenth century, because at this epoch the social institutions of the Middle Age had reached their complete development, while after this they were subjected to rapid and fundamental changes. In the thirteenth century, the abuses of feudalism had reached their height, and remedies began to be provided. In the thirteenth century jurisprudence began to be studied; and usages that had grown up in the confusion of the preceding century, were reduced to a system, formulated, and, so to speak, codified. The thirteenth century was the century of Magna Charta, of the "Establishments" of St. Louis, of the "Customs of Beauvoisis," of the treatises of Bracton and Britton, of the legislation of Edward I, the "English Justinian." In the fourteenth century, on the other hand, the feudal ties were loosened, and the system essentially under-

mined; commerce and industry began to assume a leading place in society; in the fourteenth century serfdom was abolished. At the accession of Edward I., in 1272, English villenage was at its height; at the death of Edward III., in 1377, (just about a century later,) villenage no longer existed. The commencement of the reign of Edward I. is therefore the time which one would choose, of all others, to study the full development of feudal institutions.

It so happens that this is precisely the time at which our materials are most abundant; those materials, at all events, to which I have had access. If any thing is lacking to the full understanding of them, it is not so much in the actual existence and workings of the institutions, as in their history and formation.

Edward I., the greatest king who sat upon the throne of England between William I. and William III., has left the marks of his legislative activity in every department of English law; from him, as is natural, we derive our first clue to the solution of the problem before us. In the fourth year of his reign, 1276, a document was issued, entitled *Extenta Manerii*, which prescribes the several points to be reported upon, in what we may call the census of the manors—their extent, population and value. In this document we find three classes of tenantry specified; the *liberi tenentes* (free tenants), *custumarii* (customary tenants), and *coterelli* (cottagers)—the free tenants being again divided into those who held by military service, those who held by socage, and those held in any other manner (*alio modo*). There is no mention, by name, of *villeins*, which we know from other sources to have been at this time the appellation of the great mass of the tenantry. Here we have a general classification of the English peasantry, to which we may expect the census of the several manors to conform.

The Cartulary of the Abbey of St. Peter of Gloucester,[1] contains the register of twenty-seven manors, belonging to

[1] Historia et Cartularium Monasterii Gloucestriæ, Vol. iii.

this Abbey, dating from the years 1265 and 6. This was a few years before the statute Extenta Manerii; and, as would be expected, the reports do not precisely follow the rules laid down in that instrument. They follow them, however, in the main; that is to say, they contain most of the points of information there specified, although sometimes in a different order, and with some variation in names. For example, for the second class, instead of *Custumarii*, they give *Consuetudirarii*—an equivalent Latin form in place of the latinized form of an English word. In like manner, for the third class, besides *Coterelli*,[1] we find *Coterii*,[2] *Cottagii*[3] and *Cotlandarii*,[4] forms which are obviously the same at bottom, and which appear precisely equivalent in meaning. We have thus the three classes defined in the Extenta Manerii; but besides these, we find other classes, not there mentioned—*Honilond*, *Ferendelli* and *Lundinarii*, besides a few occasional ones, described by terms which appear to be a variety of expression for one of these others. It is obvious that, however many shades of servile tenure there may have been, and however many local usages and expressions, all these must have been reducible, in the judgment of the authors of the statute *Extenta Manerii*, to three general classes—free tenants, customary tenants, and cottagers.

On examination of the documents, we find it possible to assign at least two of these additional classes to one of these principal ones. In order to do this, let us take up the several classes in their order.

The Register of each manor begins with the names of the tenants and estates of the first class. These differ very widely from each other in the amount of land held, varying from a *hide* of 160 acres (or even larger estate), down to a mere messuage and lot of land. They differ also in the terms on which these estates are held; some by military service, some by the

[1] Extenta de Churchehamme, p. 139.
[2] Extenta Berthonae Abbatis, p. 164.
[3] Extenta de Broctrope. The obligations of these are somewhat higher than the rest.
[4] Extenta de Hynehamme, p. 119.

payment of a fixed sum of money, some by a personal service of an honorable nature, as, for instance, holding[1] the towel while the Lord Abbot is washing on the day of St. Peter and Paul. These three forms of tenure would appear to be respectively Knight service, free socage and the "*alio modo*" referred to in the statute. In a few cases there is agricultural labor in addition to the money payment, but this labor is of the highest class of agricultural operations, and is always moderate and fixed in amount: as, "he shall gather and carry hay for four days."[2] The tenure likewise varies in form and degree; some hold by deed, some by ancient tenure, some for life, some at the will of the lord. What they all agree in, is in the services being free and honorable in character, and, except the military, fixed in amount and time. The number of this class differs widely in the different manors—in some there are only one or two, in others a considerable number.

In a few manors there come next to the free tenants, the tenants of *Honilond*, that is "Honey-land;" whose estates are small, and whose rent is a certain amount of honey, e. g., one gallon to each acre.[3] This is of course an equally free and certain service—equally *socage*—with those before described; the tenants of Honilond fall, therefore, in the class of free tenants—as their position in the register would indicate.

Next come the *Consuetudinarii*, the largest, and, in a sense, the most important class. In this class, instead of the irregularity of the free tenants, we find the greatest possible regularity and uniformity; all (with very slight exceptions) hold an equal amount of land (or at least an amount proportionate in quantity), and are subject to the same services. The customary land, *terra consuetudinaria*, is invariably given by *virgates*, and the *virgata* varies very widely in extent.[4] I find ten differ-

[1] Extenta de Hynetone, p. 55.
[2] Extenta de Clifforde, p. 51.
[3] Extenta de Ledene, p. 128.
[4] It is always one-fourth of a hide. The hide being a variable quantity.

ent values given to it, ranging from eighteen to eighty acres, but almost without exception the same is all estates of the same manor. The customary tenants hold either a virgate apiece, or half a virgate apiece, or a virgate in common between two. For this they render a very great variety of services, prescribed with the greatest minuteness, hardly varying at all in the same manor, and not varying much in different manors. The enumeration of these occupies in each case from a page to a page and a half in the book; and when they have been enumerated for one tenant, the Register goes on merely to give a list of the names of those holding the same estate, adding to each *et facit in omnibus sicut praedictus Robertus*, or whatever the name may be.

The *consuetudinarii* are the one class, besides the free tenants, who are found in every manor; the classes that follow are quite variable. The *Ferendelli* come next, when they are mentioned at all, and their tenures and services are precisely analogous to those of the *Consuetudinarii*, and are given in the same uniform style. Their estate is always one-fourth of the virgate, that is twelve acres where the virgate is forty-eight, sixteen acres where the virgate is sixty-four. The *Ferendellus* is the latinized form of *ferding*, a form equivalent to *farthing*, and meaning a fourth part. As the farthing is one-fourth of the penny, the ferding is one-fourth of the virgate. The name *ferdingi* occurs in some documents of the twelfth century.[1] In one manor[2] we find this estate called *quarterium*, and the tenants have no special name. The services also vary in about the same proportion to those of the *virgatarii*, as the holders of a full virgate are sometimes called. It is clear that the *Ferendelli* are properly classed with the *Consuetudiniarii*, as holding one-fourth of a virgate; indeed, sometimes they are enumerated under the same head with them,[3] just as the holders of a half-virgate are regularly.

[1] Leges Henrici Primi, XXIX.

[2] Extenta de Berthona Regis, p. 69.

[3] c. g. Manor of Bertonestret, p. 160.

The *Coterii*, *Coterelli*, *Cotlandarii* and *Cotagii*, all agree in holding *Cottagium* or "*messuagium cum curtilagio*," that is, a cottage with a small lot of ground, for which they pay in services, similar to those before described, but less in amount. They are the lowest class of laborers, and have no farms—nothing but cottage lots.

The *Lundinarii*, *Monday men*, are less easy to classify. Their place in the list is after the *Ferendelli*, and before the *Coterii*; but they occur oftener than either of these classes. Their estates vary in different manors, but do not appear to have any relation to the virgate. The "*lundinarius*," or estate of this class, is defined as "*messuagium cum curtilagio*"—thus associating them with the cottagers—and, in addition, so many acres of land, generally two, four or six: that is, small farms besides their cottage lots. The distinguishing characteristic of their tenure, implied in their name, is that of laboring one day in the week throughout the year: but this does not exclude other services. It would seem likely therefore that they were a specially privileged class of cottagers; and I feel inclined, although with some hesitation, to place them with this third category of the *Extenta Manerii*. It is true we meet the expression "*lundinaria consuetudinaria*,"[1] and the introduction to the Cartulary[2] quotes an expression, "*duo crofta, cum duabus lundinariis terrae, vocata* Mundais land *de custumariis terris manerii*;" still, in the strict sense of the word, all below the free tenants hold by customary services, that is, defined amounts of agricultural labor; and in one case, in fact, we find all of them grouped as *Consuetudinarii majores* and *minores*;[3] several times as *Consuetudinarii* simply. I am inclined, therefore, in spite of this expression, to consider these as cottagers who had received additional allotments of land, on the tenure of certain customary services, rather than as customary tenants

[1] Extenta de Culne Rogeri, p. 207.
[2] p. cvi.
[3] Extenta de Culne Sancti Alywini, p. 208.

proper, of an inferior grade,—as privileged cottagers, rather than as inferior customary tenants. In one case[1] they are in fact classed with the *Coterelli*. It may be remarked that the services of the *lundinarii* agree very nearly with those of the *Cotsetlan*, the second, or intermediate, class of peasants of the *Rectitudines*. The importance of this distinction will appear further on.

It will be observed that in this Cartulary, as in the statute *Extenta Manerii*, we hear nothing of *villeins* as a class. I have met in it with the word *villani* once and *villenagium* twice, as will be shown presently.

The result of an examination of these registers, is fully to confirm the classification of the statute *Extenta Manerii*. We find that the three classes there enumerated are distinctly mentioned here, under names essentially the same; and we find that every other class can be easily reduced to one of these three, with the single exception of the *Lundinarii*, who agree in certain points with one class, and in certain point, with another; probably what puzzles us now, was perfectly plain to the men of that time. Further, the result of this examination is to develop the fact that the class of *consuetudinarii*, or customary tenants, ranking between the other two, was distinguished by a remarkable regularity and uniformity, both of estate and of services; while the free tenants, the class highest in rank, are exceedingly variable and irregular, and the cottagers, the third in the list, are uniform, it is true, but wholly insignificant. The customary tenants enjoy a relatively very respectable standing, and their estate—the virgate, usually of 36 to 60 acres,—is a very comfortable farm, especially when it is considered that this was exclusively arable land, and that they had besides the use of the common pasture, wood-land, etc. For this farm they paid in a great multiplicity of prædial services, burdensome no doubt, but determined in amount and time. Including the *ferendelli*, this class

[1] Extenta de Ledene, p. 131.

far outnumbers all the others taken together; the *consuetudinarii* may therefore be pronounced the main body of the peasantry, and the uniformity of their estate and services shows them to have been a compact, organized body.

It remains to trace, so far as possible, the origin of these three classes. In this, our starting point must be Domesday Book. According to this, there existed throughout England, in the eleventh century, (besides certain local and occasional classes), two great classes of peasantry—the *villani*, or villagers, and the *bordarii*, or cottagers. Both these classes are found in every county, and in nearly every manor.

In the paper that I read last year, I attempted to prove that the *villani*, who are generally recognized to have been the Anglo-Saxon *ceorls*, were the representatives of the primative Village Conmmunities, which recent investigations of Nasse, Maine and others, have shown to have existed in early times in England, as in other Germanic countries. The argument may be briefly summed up as follows: 1. The word *villanus* means villager etymologically; and we find no trace in the eleventh century of the servitude or degradation which are associated with the *villeins* of the thirteenth century. 2. The *villani* are, in the document entitled "*Rectitudines Singularum Personarum*," identified with the Anglo-Saxon *Geneat*, as the highest class of the peasantry; and their services are described as more moderate and of a higher order than those of the other classes. 3. In the "Exeter Domesday" the *villani* are regularly spoken of as land-holders, as distinguished from the *bordarii* on the other hand, and from the lord's demesne on the other. 5. The laws of King Edgar[1] contrast the thegn's "inland" or demesne, with the "geneat-land;" and we have just seen that the *geneat* were the *villani*.

Thus far we have proved only that the *villani* were the occupants of the "*utland*" or "tenement lands" of the manor, that the land held by them was of a very considerable amount, and

[1] I. 1.

that they held these lands on the tenure of a moderate and determinate amount of agricultural labor. But nothing so far shows in what manner these lands were distributed among these tenants. So many *villani* hold so many *hides* or *bovatae* of land, but, from all that appears, their estates may have been variable, like those of the *liberi tenentes* of the Gloucester Cartulary, or uniform, like those of the *consuetudinarii*. Fortunately we are able to supply the required proof, and to show that the *villani* held their lands in equal estates; from which we may infer with certainty that they were identical with the *consuetudinarii*, only with changed name.

The first link in the argument is supplied by the Boldon Book, a register of the property of the see of Durham, A. D. 1183, just about 100 years after Domesday Book, and 100 years before the Gloucester Cartulary. This document describes the services of the *villani*, very much as those of the *consuetudinarii* are described a century later; and what is of more importance, the *villani* are described as holding uniform estates of two *bovatae* each, amounting to 32 acres. Below the *villani* is a class of *cotmanni*, or cottagers, and there are also a number of *firmarii*, who hold similar estates to those of the *villani*, but on a privileged tenure. Here the *villani*, from the description of the services, appear to have sunk below the position which they enjoyed when the "Rectitudines" was compiled, although the services are less burdensome than those of the *consuetudinarii* of the following century.

Nearly contemporary with the Boldon Book, we have the rent-roll of a few manors of the Abbey of Abingdon in Berkshire.[1] This gives three classes of tenants precisely corresponding to the three classes of the *Extenta Manerii*, except in name. First come a few free tenants, holding estates of various sizes, by very varying tenures. Next follow the *neti*, the most numerous class, who hold equal estates of one or two virgates, and pay for them in an equal amount of specified

[1] Chronicon Monasterii de Abingdon, ii, p. 302.

services, similar to those of the *consuetudinarii*, but far less burdensome. Lastly the the *cotsetel*, who appear to correspond with the *coterii* of the thirteenth century. Now the word *neti* is evidently the Latinized form of *geneat*, which we have found to be the Anglo Saxon equivalent for *villani*. This class therefore forms another link between the *villani* and the *consuetudinarii*.

We have now seen: 1. That the *villani* of the eleventh century are identified with Anglo-Saxon *geneat;* and that the term is applied to the highest class of peasantry, the body of the Anglo-Saxon *ceorls*, who held considerable amounts of land by the tenure of predial services of a respectable character, moderate and fixed in amount. There is nothing to show the size of their individual estates at this period. 2. That in the twelfth century the *villani*, and in the south of England the *neti*,—whose name is obviously the Latinized form of *geneat* (*villanus*), held equal estates of a very respectable size on the tenure of predial services of a respectable character, moderate and fixed in amount. But they are no longer the highest class of peasantry. There is, above the *neti*, body of free tenants, whose estates are irregular in amount, often quite inconsiderable, although under a privileged tenure. 3. In the thirteenth century, that there was a class of *consuetudinarii*, who in like manner held equal amounts of land in respectable quantities, but on the tenure of predial services of a very multitudinous and burdensome character. There is above these two a body of free tenants, precisely corresponding to those of the twelfth century. Each of these classes appears to embrace the main body of the peasantry at their respective epochs; and to have been a compact and organized body.

We find then that the class which makes up the substance of the peasantry, is called by different names at these three epochs,—*villani*, *neti* and *consuetudinarii*. Further, we find that its position has deteriorated in two respects; first, by the

development of another class above them; second, by the increase in number and degradation in character, of the services by which they hold their lands. In other respects the classes are identical in character, and we may fairly infer that the *neti* of the twelfth century, and the *consuetudinarii* of the thirteenth, are the same as the *villani* of Domesday Book. This view is supported by the fact that the term *villenargium* is twice applied, in the Cartulary of Gloucester,[1] to the tenure of these *consuetudinarii*.

The question next arises, what was the origin of the *liberi tenentes*—a class that has come into existence since the time of Domesday Book; for the *liberi homines* of Domesday Book are almost exclusively confined to two or three counties (Norfolk, Suffolk and Essex); and that document gives only *villani* and *bordarii* in manors where, two centuries later, we find *liberi tenentes*. An examination of the lists of *liberi tenentes* will show, as has been already remarked, that there was a very great disparity in their condition; the Extenta Manerii distinguishes those who hold by Knight's service and those who hold by socage. Those who hold by Knight's service need no explanation; they were members of the aristocracy, who had received grants of land in the manors, but were broadly separated from the other tenants. The tenants in socage, on the other hand, appear to have been specially privileged *villani*. In the manor of Ledene, for example, nearly all the free tenants appear also as customary tenants—that is, they held two estates at a time (not at all an uncommon thing), and these two estates were of different rank,—the one free, the other servile. In some cases, again, the freehold is precisely the virgate or half-virgate of the customary estate; and the freeholder would appear to have received the special privilege of setting apart his strip of land from the strips of the rest of the villagers, fencing it off, cultivating it after his own system, and paying for it in money instead of in services. In other cases,

[1] Extenta de Lutlethone, p. 37; Linkeholte, p. 42.

the freehold is nothing but a cottage or a messuage with a garden lot. It is testified by Britton[1] that a villain may be enfeoffed by his lord, "et par tel feffement est le vileyn fraunc." It is a strong confirmation of this view, that in the only place in which the word villani occurs in this Gloucester castulary, it is used of the tenants in free socage.[2]

The free tenants in socage appear, therefore, to have been members of the class of *villani*, and to have been either advanced by way of privilege to a more favored condition, or were exempted from the burdens gradually imposed upon the rest of the class, and thus remained more nearly in their original freedom; for there seems no doubt that the villagers as a class had sunk between the eleventh century and the thirteenth —the *villani* had become *villeins*, serfs. Probably the correct view is between the two. The *villani* held by praedial services in the eleventh century, as is shown by the *Rectitudines;* the free tenants were therefore actually privileged by having these services commuted for money payments, while at the same time the services of the class from which they were raised were made more base and burdensome. This view agrees with that of Mr. Finlason, editor of Reeve's History of English Law,[3] that "our common freehold estates arose out of villenage." It is also supported by the rent roll of the manor of Addington in Kent, dating 1257–71, where we find a similar irregular and quite insignificant class of freeholders, while the mass of the tenants hold by praedial services.[4]

As regards the position of this class which I have called the body of the peasantry,—the *villani* of the eleventh century, and the *consuetudinarii* of the thirteenth,—I have attempted above to identify them with the members of the primitive village communities, which have lately been shown to have continued in existence down through the Middle Ages, and even

[1] Book II. 7, 2.
[2] Extenta de Mayesmore, p. 171.
[3] Vol. I, p. 70, note.
[4] Larking's Domesday Book of Kent, App. p. XXI.

in some cases to the present day. There are many indications that the land held by the *Consuetudinarii* of these manors were subject to certain of the obligations of the community. The equal size of the estates—the virgate, or half or quarter virgate—is a proof of something organized and regular in the assignment of the estates. In one case the estate is a virgate, "in utroque campo"[1]—another indication of regularity and organization, and undoubtedly a reference to the custom of having the arable lands in two or three fields, which were alternately cultivated and fallow. There are still clearer indications of this "three-field culture" in other manors.[2]

In saying that the *Consuetudinarii* were the representatives of the village communities, I would not be understood to imply that they all had their origin in such communities, or that all such communities had kept up their compact organization down to the thirteenth century. As Mr. Maine says:[3] "it cannot be supposed that each of the new Manorial groups takes the place of a village group which at some time or other consisted of free allodial proprietors. Still, we may accept the belief of the best authorities, that over a great part of England there has been a true succession of one group to the other." And at any rate, the "compact and organically complete assemblage of men, occupying a definite area of land,"[4] can be identified with nothing but the *villani* of the eleventh century, and the *consuetudinarii* of the thirteenth.

My object in this paper, has been to trace one of the steps in the social history of the English peasantry. Several questions have presented themselves, in the course of this enquiry, which I have not been able to answer; I think, however, that the facts and arguments here brought forward, are sufficient to establish the essential identity of the most important class of the peasantry during the period between the Norman Con-

[1] Extenta de Duntesburne, p. 194.
[2] Extenta de Lutlethone, p. 36. Linkholte, p. 42.
[3] Village Communities, p. 135.
[4] Id., p. 138.

quest and the accession of Edward I. At this time the process of deterioration in their social condition had reached its lowest point, and the free villager had become a servile villein, bound to the soil, and almost a slave. After this time the history of the class is one of progress and amelioration, no longer of degradation.

NOTE.—Since writing the above paper, I have succeeded in procuring a copy of Nasse's important work, "The Agricultural Community of the Middle Ages," which I tried in vain to secure while preparing it. Prof. Nasse's attention is given rather to the organization of the community, than to the classification of the peasantry; he gives a few pages, however, to the latter, and his views are in the main the same as those here presented. Especially he takes the same ground as to the identity of the *consuetudinarii* with the *villani* (p. 39), and as to the lundinarii being "a peculiar kind of 'cotarii'" (p. 42). It may be remarked that his authorities, for the thirteenth century, are entirely different from mine. He makes no reference to the Gloucester Cartulury, and on the other hand I have not had access to the documents to which he refers. I need not say that I have been on my guard against drawing conclusions broader than the facts will warrant. I have made use—for this period—of only a small group of manors in the west of England, and, what is of more importance, the property of an ecclesiastical corporation, where we might expect to find peculiar usages, and perhaps a more liberal order of things. It is gratifying, therefore, to find my conclusions supported by researches based upon such a mass of evidence as that used by Prof. Nasse.

RANKS AND CLASSES AMONG THE ANGLO-SAXONS.

BY W. F. ALLEN, A. M.,

Professor of Latin and History in the University of Wisconsin.

[Only that portion of this paper is here printed, which treats of the Eorls.]

The accepted doctrine as to the original classification among the Anglo-Saxons, is that the entire population fell into two distinct classes, *eorls* and *ceorls*, terms which have been corrupted into the modern *earl* and *churl*, but which originally implied nothing more than a certain ill-defined hereditary distinction in rank, hardly so strong as that of *noble* and *freeman*. This view, which is held by Lingard, Palgrave, Kemble, Hallam and Stubbs, is nowhere better expressed than by Mr. Freeman.[1] "In the primary meaning of the words, *eorl* and *ceorl*—words whose happy jingle causes them to be constantly opposed to each other—form an exhaustive division of the free members of the state. The distinction in modern language is most nearly expressed by the words *Gentle* and *Simple*. The ceorl is the simple freeman, the mere unit in the army and the assembly, whom no distinction of birth or office marks out from his fellows." This is, as I have said, the prevailing view at present; and, so far as the word *ceorl* is concerned, there is no question as to its correctness; but with regard to *eorl*, I am inclined to go back to the earlier opinion, held by Thorpe[2] and Lappenberg,[3] and to take the ground that it never designates

[1] Norman Conquest, i. p. 37.

[2] Glossary to "Ancient Laws and Institutes of England."

[3] Vol. ii. p. 313.—Compare also Waitz, Deutsche Verfassungsgeschichte, i. p. 76. Waitz remarks, as a matter of course, that the Anglo-Saxons, like the Franks, had no hereditary nobility. To explain this departure from the prevailing institutions of the Germanic nations, we must consider, in the first place, that the German nobility was

an hereditary rank, but always a personal office or relation. It is admitted that this was the case in the eleventh, and partially in the tenth century; it appears to me that the weight of evidence is as to having always been so—that it never essentially changed its meaning until after the Norman Conquest, when, in its modern form *earl*, it became an hereditary title of nobility.

The passages in which the word *Eorl* occurs, may, for our purposes, be classified into three groups:—the early Kentish laws of the seventh century; the laws of Alfred and his successors; and the Saxon Chronicle and other works of literature. Between the two groups of laws there is an interval of about 200 years; and it is to be noticed that the arguments for "the distributive character of the words" *eorl* and *ceorl*, i. e., as, with the meanings "Nobleman" and "freeman," making up the entire free population, are derived wholly from two or three passages in the later laws. Taken by themselves, neither the early laws nor the scattered passages in the Saxon Chronicle and other documents, would suggest any such meaning. Now it may fairly be urged that the use of the words in the seventh century, if explicit enough, is sufficient by itself to establish their original signification.

First, however, it will be proper to compare the English *Eorl* with the Danish *Jarl*, which is of course the same word, and may fairly be presumed to have the same original meaning. The settlers of Kent, it will be remembered, in which kingdom we first meet the term as a legal one, were neither Angles nor Saxons, but Jutes, or natives of the peninsula of Denmark. That is, while the English as a whole are more nearly related to the Scandinavians than to the Germans, the Kentishmen stand in a peculiarly near relation to the Scandi-

very limited in numbers—among all the Saxons, there were only about twenty-five noble families; and in the next place, that they migrated, not under kings, but chiefs—*heretoga*—and that these chiefs undoubtedly included whatever nobles chose to join in the enterprise. It is hard to see, therefore, what can have been the origin of the eorls as an hereditary class.

navians. It may be assumed therefore, that the Eorls of Kent were identical with the Jarls of Denmark and Norway. Now the Scandinavian Jarls were not an hereditary class of noblemen, but were officers or magistrates appointed for life or pleasure.[1] It is significant too, that the late well-established use of Earl, as the governor of a province, is attributed to Danish influence.

In the laws of Kent its use is never inconsistent with this. *Ceorl* is used, as it always is, for the common freemen—"peasant," if we choose to employ this term, but not by any means a low order of peasant; the *ceorls* are represented as landowners and even slave-owners, and may perhaps be best described by the term "yeoman." The legal standing of the *Eorl*, as represented by the *bot* or composition, is double or triple that of the *Ceorl;* but this is by no means a proof of difference in hereditary rank, but may equally well indicate a personal authority or a special relation to the king.

Turning to the Saxon Chronicle for this early period, we find this conclusion strengthened. In a speech of King Wihtred of Kent, A. D. 692, we read: "Kings shall appoint Earls and Ealdormen, Shire-reeves and Judges" (eorlas and ealdermen, scire-revan and domesmenn.) From this it appears clearly that the *Eorls* were not an hereditary, but an appointed class. In the same document, A. D. 657, we read (of the King of Mercia): "to all his thegns, to the archbishop, to the bishops, to his earls." Note the word "his," showing a personal rather than an hereditary relation. Again, A. D. 675 (in Mercia): "neither king, nor bishop nor earl nor no man." This, although not so explicit as the others, certainly implies no hereditary rank. The above are all the instances of the use of the word *eorl* which I have been able to find before the time Alfred except in works of poetry. I think it will be

[1] Dahlmann, Gesch, Danemarcks, ii. pp. 88 and 305. The same view is taken by the latest Norwegian historians, Munch and Keyser, as I am informed (being myself ignorant of Norwegian) by Mr. R. B. Anderson, Instructor in the Scandinavian languages in the University of Wisconsin.

admitted that they clearly support the view that the English *eorls* were, like the Danish *jarls*, appointed officers or magistrates, not hereditary noblemen.

Let us now pass to the later group of laws, those of Alfred and his successors. Here we find four passages in which the words *Earl* and *Ceorl* are coupled in what appears to be a distributive use: these are, Laws of Alfred, 4, "all degrees, whether earl or ceorl"; Judicia Civitatis Lundoniæ: Intr.: "as well eorlish as ceorlish"; Laws of Ethelred, VII. 21: "we know that through God's grace a thrall has become a thane, and a ceorl has become an eorl." Of Peoples' Ranks and Laws: "each according to his condition, eorl and ceorl, thegen and theoden." These four are, I believe, all the instances of the so-called distributive use of the terms Eorl and Ceorl; upon these, therefore, the prevailing theory is exclusively founded.

It may be observed, in the first place, that in the Latin translation of these documents, dating probably from the twelfth century, Earl is uniformly rendered by *comes*, a word which has more than one use, but which certainly never has the general meaning of gentlemen or noblemen, but always that of some special rank or office, as follower, magistrate, or, in later times, count or earl. I do not rest much upon this argument, for the reason that this translation was made at a time when *earl* had a fixed meaning in English, as designating particular grades of nobility, so that it is very easy to suppose that the translator confounded the meaning of the word in his own day with that which it had in the original document. It is more to the purpose to remark that we have an equal number of cases, in genuine Latin laws of the tenth century,[1] in which *comes* and *villanus* are used precisely as these same words are used in the translation just referred to, and as *earl* and *ceorl* are used in their originals. If therefore *earl* and *ceorl* are distributive, we have a right to infer that *comes* and *villanus* were

[1] Aeth. Decr. Episc. 6.—Decr. Sap. Ang. 3 and 6.—Eadm. Conc. Cul., vii.

so; that is, that all persons who were not ceorls or peasants (the accepted meaning of *villanus*) were *comites*—a use of *comes* which is certainly inconsistent with any accepted meaning of this word. It is still more to the purpose to note that *thegn* is joined with *ceorl* in precisely this same way (Ord. resp. the Dun-saetas, 5); and the inadequacy of the argument is proved by noticing that in Ethelred's Law *thrall* and *thegn* are joined, exactly as *ceorl* and *earl* are. Now a thrall was a slave; and it certainly was not true that all who were not slaves were thegns. The coupling of *earl* and *ceorl* is easiest explained by the jingle, as that of *thrall* and *thegn* is by the alliteration. It may be noticed too that the Norsemen made use of precisely the same jingle—*jarlar ok karlar.* As to the explicit statement (Eth. vii, 2) that a ceorl might become an earl, Mr. Freeman is obliged, in consistency with his view of the strictly hereditary rank of the earl, to question the correctness of the statement. "I may remark that the jingle of beginnings and endings has carried the lawgiver a little too far. In strictness the Ceorl could not become an Earl (in the older sense of the word.)[1]

When we leave these four passages, we find that the use of the word *Earl* in the ninth and tenth centuries is perfectly consistent with what we find in the sixth. It is usually assumed that the later use of *Earl* as a governor of several counties was introduced by Cnut; and it is certain that Cnut did reorganize the kingdom and establish a new grade of governor with this title. It is no less certain, however, that even before his time the word was frequently used to designate magistrates, as equivalent to *ealdorman*, (see Bosworth, Anglo-Saxon Dictionary, s. v.), and that this use occurs even in legal documents. In the Laws of Edward and Guthram (12) we find: "If any man wrong an ecclesiastic or a foreigner, then shall the king, or the earl there in the land, and the bishop of the people, be unto him in the place of a kinsman and of a pro-

[1] Norm. Conq. i. p. 95, n. 1.

tector." Again, in the Saxon Chronicle (A. D. 963); "neither king, nor bishop, nor earl, nor shire-reeve." In these two passages the earls are certainly not an hereditary class, but persons invested with power and authority. This view is supported by the fact that in the Saxon Chronicle this word is regularly used for the Danish jarls.[1]

The use of the word in poetry is not inconsistent with the view here presented. In Beowulf,[2] for example, the earliest Anglo-Saxon poem, it is translated by Mr. Thorpe, 20 times by *warrior*, 13 times by *earl*, 7 times by *man*, *hero* once, and *noble* once: where it is translated *noble*, (v. 4488) either of the other terms would have made equally good sense. Indeed, if one always rendered it "man," using the word with the same latitude that we do in English (e. g., as in the expressions, "This was a man," "a company of so many men," "he was such a one's man") it would answer fairly enough; in several verses (3458, 4272 and 6327) we find *eorlscipe* translated "bravery"—*virtus*. (Noble is regularly *aetheling*; see vv. 1968, 2592). This is consistent likewise with the song of the Battle of Brunanburh (Sax. Chron. A. D. 937), where Athelstan is called "Eorla Dryhten," (lord of earls); again, (A. D. 957), we read of Edgar "thaet cyningas and eorlas georne to him bugon" (that kings and earls willingly submitted to him). In Christian poetry Christ is called "Eorla hleo," refuge of men.

There is, however, one poem of very great antiquity, the Rigsmal, which certainly appears to support the view that the Danish jarls were originally an hereditary class; it is cited by Munch and Keyser to show that this was the mythical or praehistoric meaning, although they hold without any question that its historical meaning was that here presented. In this poem the three classes, of nobles, commons and slaves are represented as descended from three brothers, Jarl, Karl and

[1] e. g., A. D. 871, 915.

[2] Most of these references to Beowulf were furnished to me by my friend, Mr. Thos. Davidson, of St. Louis.

Thrall. Inasmuch as my concern is simply with the historical value of the term eorl, as applied to the Anglo-Saxon classes, its mythical or prae-historic value makes no difference to my argument. I will only mention, to show how little consistency there is in this mythical genealogy, that among the sons, not of Jarl, but of Karl are, besides Smidr (Smith) and Bondi (peasent); Thegn, which is the title of the later nobility in England, and which even as early as Beowulf (v. 3295, eald-or Thegna, *prince of Thegns*) indicated a vassal of rank; and Hauldr, the designation, according to Dahlmann,[1] of "a genuine primitive nobility," and which we find also among the Danish invaders of England,[2] and afterwards as the highest nobility in the Danish parts of England.[3]

We are warranted, therefore, in the conclusion that, although there are a few expressions a little hard to explain, there is nothing really inconsistent with the view supported by the great weight of evidence—that *Earl* originally designated some purely personal rank or position—one to which even a peasant, *ceorl*, could rise. It must have been the title either of a class of officers or magistrates, or of the parsonal followers of the king.

[1] Il., p. 304.
[2] Sax. Chr., A. D. 905, 911, 915.
[3] Of Wergild's, North County Laws, 4.

PROCEEDINGS.

EIGHTH MEETING OF THE ACADEMY.

JULY 15, 1872.

The Academy met, pursuant to requirement of By-Laws, in the capitol, this evening at 7½ o'clock.

Present, Dr. J. W. Hoyt, President; Dr. A. L. Chapin, Vice-Presdent; Prof. T. C. Chamberlin; Geo. P. Delaplaine, Treasurer; W. Dudley, Esq., Director of the Museum, and Dr. John E. Davies, acting Secretary; President Hoyt in the chair.

The minutes of the preceding meeting having been read and approved, the secretary read letters from some ten of the members, regretting their inability to attend on account of anticipated absence from this state at date of meeting, and suggested whether it might not be better, under the circumstances, to confine the present meeting to the transaction of necessary business; which suggestion, on motion of Dr. Chapin, was approved.

Some matters pertaining to the printing and publication of the Academy's next volume of Transactions, and of the Bulletin, were considered, but without action.

The President called attention to the deficiences of the Museum, and urged the necessity for additional cases for specimens already here and for others soon expected.

On motion, Prof. Chamberlin was appointed a committee to draft plans for cases and to submit the same to the President, Secretary and Director of the Museum, for their approval and presentation to His Excellency the Governor of the State.

The names of Prof. Joseph E. Emerson, of Beloit College, J. B. Reade, C. E., of Milwaukee, and Prof. Alexander Kerr of the State University, were presented for annual membership and referred to the standing committee on Nominations.

On motion, the Academy adjourned *sine die.*

JOHN E. DAVIES,
Acting Secretary.

NINTH MEETING OF THE ACADEMY.

CITY HALL, Milwaukee, September 24, 1872.

The Academy met pursuant to requirement of By-Laws, and notification of the press, at the old City Hall in Milwaukee, on the evening of September 24, 1872, being Thursday of the week of the annual exhibition of the Wisconsin State Agricultural Society.

Attendance small, on account of the distractions incident to the exhibition; the President, Dr. J. W. Hoyt, in the chair.

Dr. I. A. Lapham, General Secretary, read the minutes of the last meeting, which were formally approved.

The Secretary also submitted some remarks touching the difficulty, if not impracticability, of holding successful meetings of the Academy during the progress of the state industrial exhibitions, and proposed amendment to sec. 2 of the by-laws, providing that

Hereafter there shall be but *two* regular meetings of the Academy annually, to-wit: the Annual Meeting, to be held, as now, on the 2d Tuesday of February, and a summer meeting, to be held at such time and place as shall be determined by the General Council.

Which amendment was put upon file and record, for action at the next regular meeting.

On motion, the thanks of the Academy were tendered to His Honor the Mayor of Milwaukee, the City Clerk and other officers of the municipality, for the use of the City Hall and its preparation for this meeting.

Ajourned *sine die*.

I. A. LAPHAM,
General Secretary.

THIRD ANNUAL MEETING.

First Session.

ACADEMY MUSEUM, Feb. 11, 1873.

The Academy met at their room in the State Capitol, in the evening of this day, at 7½ o'clock; attendance of members and citizens large.

The President, Dr. J. W. Hoyt, in the chair.

The acting Secretary, Dr. John E. Davies, read the minutes of the last two meetings, which were approved.

The President gave an account of the work of the year.

Report of Treasurer deferred until a subsequent session.

The following named gentlemen were put in nomination for membership, and unanimously elected under a suspension of the rule requiring reference to the standing Committee on Nominations:

R. M. Bashford, Esq., Madison.
Prof Joseph Emerson, Beloit College.
Prof. Alexander Falk, Racine College.
Rev. F. M. Holland, Baraboo.
Prof. Alexander Kerr, State University.
Capt. John Nader, U. S. Corps of Engineers, Madison.
A. C. Parkinson, Esq., Madison.
S. F. Perkins, Esq. Burlington.
E. D. Reade, C. E., Milwaukee.

Prof. John E. Davies submitted the following as amendments to the Constitution and By-Laws:

(1) That the titles of the Departments of the Academy be changed so as to read, "Department of Science," "Department of Philosophy," "Department of Art," "Department of Letters."
(2) That the initiation fee of annual members be hereafter five dollars in place of ten; the annual fee two instead of five.
(3) That there be a perminent publishing committee, to consist of the President, the Vice Presidents—one of whom shall be a resident of Madison—and the General Secretary.

On motion, a committee consisting of Prof. W. F. Allen, Dr. I. A. Lapham and Dr. A. L. Chapin, was appointed to nominate officers of the Academy for the ensuing three years.

The reading of papers being now in order, the following were read and discussed, to wit:

Population and Sustenance, by Dr. G. M. Steele, President of Lawrence University.
On the Rural Classes of England in the Thirteenth Century, by Prof. Wm. F. Allen, of the State University.
Vexed Questions in Ethics, by Rev. F. M. Holland, of Baraboo.
On the Requisites Reform of the Civil Service of the United States, by the President, Dr. J. W. Hoyt.

The following papers by Dr. P. R. Hoy, of Racine, owing to his detention at home by sickness, were read by title only, to wit:

On the place of Natural History in Primary Education:
On some Peculiarities of the Fauna of Wisconsin: and
On the Classification of Animals.

The Academy adjourned to meet at 9 o'clock, A. M., to morrow.

Second Session.

FEBRUARY, 12—9 O'CLOCK, A. M.

The Academy met pursuant to adjournment; President Hoyt in the chair.

The Treasurer submitted his annual report for the fiscal year just closed, of which the following is a copy:

WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS,
OFFICE OF THE TREASURER,
MADISON, FEBRUARY 13, 1873.

Hon. J. W. HOYT, *President of the Wisconsin Academy of Sciences, Arts and Letters:*

SIR: I have the honor to report the financial condition of the Academy, as follows:

RECEIPTS.

Total amount fees received from 49 members	$542 25
To fees received from ten life members	1,000 00
To interest on loan of same	100 00
	$1,642 25

DISBURSEMENTS.

Disbursed in payment of warrants as per vouchers heretofore and herewith furnished	$509 00
Balance in treasury	$1,133 25
Placed to credit of Life Members' Permanent Fund	$1,000 00
Total credit of general fund	133 25
	$1,133 25

[Signed] GEO. P. DELAPLAINE,
Treasurer.

In the absence of the members of the Standing Committee on Finance, the Treasurer's report was referred to a special committee, consisting of Prof. T. C. Chamberlin, Gen. John Lawler and Prof. James H. Eaton, who subsequently reported as follows:

We have this day examined the above report and account of the Treasurer, and compared the same with the vouchers, and find the same in all respects correct.

[Signed] T. C. CHAMBERLIN,
JAMES H. EATON,
Committee.
(General Lawler being absent.)

MADISON, February 12, 1873.

On motion, the President, Dr. Hoyt, and Messrs. Chamberlin, Steele, Lapham and Irving, were appointed a committee to examine the several bills now pending before the Legislature for a Geological Survey of the State, and to make such suggestions in regard to the same as said committee may deem advisable.

The following papers were then read and discussed:

On the Relation of the Sandstone, Conglomerates and the Limestone to the Azoic of Baraboo Valley, by Prof. J. H. Eaton, of Beloit College.
On the Geographical Distribution of the Quartzite of Sauk and Columbia counties, by Prof. T. C. Chamberlin, of State Normal School, Whitewater.
On the Metamorphic Rocks of Portland, Dodge county, with remarks on the occurrence of similar rocks in other parts of the state, by Prof. R Irving, State University.
Results of Analysis of certain Ores and Minerals, by Prof. W. W. Daniells, State University.
Analysis of Madison Building Stone, by T. E. Bowman, of State University.
Results of Analysis of Black River Falls Iron Ore, by Prof. R. Irving.

The Academy then adjourned until 2 o'clock P. M.

Third Session.

FEBRUARY 12, 2 O'CLOCK P. M.

The Academy met pursuant to adjournment, the President in the chair.

The committee appointed to nominate officers, made the following report, which was unanimously adopted:

FOR PRESIDENT—Dr J. W. Hoyt, Madison.

FOR VICE PRESIDENTS—
Department of Natural Sciences—Dr. P. R. Hoy, Racine.
" *of Social Science*—Rt. Rev. Wm. E. Armitage, Milwaukee.
" *of Arts*—Dr. I. A. Lapham.
" *of Letters*—President A. L. Chapin, Beloit.

FOR GENERAL SECRETARY—Prof. John E. Davies, Madison.
FOR TREASURER—Gen. Geo. P. Delaplaine, Madison.
FOR DIRECTOR OF MUSEUM—Prof. R. Irving, University.
FOR LIBRARIAN—D. S. Durrie, Esq., Madison.

FOR SECRETARIES OF THE DEPARTMENTS—
Natural Sciences—Prof. J. H. Eaton, Beloit.
Social and Political Sciences—Rev. F. M. Holland, Baraboo.
Arts—Prof. W. J. L. Nicodemus, State University.
Letters—Prof. J. B. Feuling, State University.

FOR COUNSELORS—
Department of Natural Sciences—Prof. P. Englemann, Milwaukee; Prof. T. C. Chamberlin, Whitewater; Prof. J. C. Foye, Appleton.
" *of Social and Political Sciences*—Pres. G. M. Steele, Appleton; Rev. Charles Caverno, Amboy, Ill.; Hon. S. D. Hastings, Madison.
" *of Arts*—Wm. Dudley, Esq., Madison; Capt. John Nadir, U. S. A.; Hon. J. I. Case. Racine.
" *of Letters*—Prof. Jos. Emerson, Beloit; Hon. Lyman C. Draper, Madison; Prof. W. F. Allen, State University.

Prof. W. W. Daniels submitted an amendment to the by-laws, providing that the officers of the Academy shall hereafter be elected *by ballot.*

The following amendment to the by-laws, submitted by Dr. I. A. Lapham at the ninth regular meeting of the Academy, was taken from the file and adopted, *nem con.*, to-wit:

Instead of three meetings annually, as heretofore, there shall hereafter be but *two* namely: The Annual Meeting, to be held at Madison, on the 2d Tuesday of February, and a Summer Meeting, to be held at such time and place as shall be determined by the General Council.

The following papers were then read and discussed, to-wit:

On the Occurrence of Gold and Silver in Minute Quantities in Quartz, in Clark County, by Prof. R. Irving, State University.

Evidence bearing on the Methods of Upheaval and Fluctuations of the Quartzite of Sauk and Columbia Counties, by Prof. T. C. Chamberlin, Whitewater.

Potentials and their Application to Physical Science, by Prof. John E. Davies, State University.

On Kerosene Oil, by E. T. Sweet, of the State University.

On the Improvement of the Wisconsin River, by Prof. W. J. L. Nicodemus, State University.

On the Correlation of Forces, by E. D. Reade, C. E., Milwaukee.

Adjourned to 7½ o'clock P. M.

Fourth Session.

FEBRUARY 12, 7 o'clock P. M.

Academy met pursuant to adjournment.

Reading and discussion of papers resumed:

On Railway Gauges, by Prof. W. J. L. Nicodemus, State University.
Fish Culture in Wisconsin: its Claims upon the State, by the President, Dr. J. W. Hoyt.
On Several Points in the Pronunciation of Latin and Greek, by Prof. S. S. Haldeman, of Philadelphia, Corresponding Member.
The Metaphysics of Science, by Prof. S. H. Carpenter, State University.
On the Relative Import of Language, by Prof. J. B. Feuling, State University.

The reading of the papers prepared for this meeting having been concluded,

President Hoyt, from the committee on Geological Survey, reported a bill, which had the approval of the Academy, and was authorized to be laid before the proper committee of the legislature.

On motion, it was

Resolved. That papers intended for publication in the Transactions be examined by the Vice President and Secretary of the department to which they belong, and then by the President and General Secretary.

The following named persons were nominated and duly chosen corresponding members of the Academy:

Dr. Edmund Andrews, M. D., Chicago.
Dr. Theodore Gill, M. D., Washington.
F. V. Hopkins, M. D., Baton Rouge, La.
Prof. W. B. Porter, St. Louis, Mo.

On motion, it was

Resolved, That the next meeting be held at Appleton, at such time in the month of July, as shall be determined by the President and General Secretary.

The Academy then adjourned *sine die.*

[Signed] I. A. LAPHAM,
General Secretary.

Tenth Meeting—Memorandum.

Owing to the absence of the President of the Academy in Europe, and the inability of many other officers and members to be present, the July meeting of the Academy was not held.

J. E. DAVIES,
General Secretary.

MADISON, July, 1873.

ELEVENTH MEETING OF THE ACADEMY.

ACADEMY ROOMS, December 12, 1872.

Pursuant to a call of the Secretary—the President being still absent in Europe—a special meeting of the Academy was held at their rooms, December 12, 1873, at 4½ o'clock P. M.

Prof. J. B. Parkinson of the State University was called to chair.

Prof. W. F. Allen announced the sudden death, in New York city, on the 6th inst., of the Rt. Rev. Bishop W. E. Armitage, S. T. D., Vice President of the Academy, and spoke of the great interest manifested by the deceased in all that concerns true progress, and particularly of his special interest in the work of the Academy, contributing to its success, as he did, not merely by the influence of his name and position, but also as an active member in all its meetings.

Remarks were also made by Profs. Parkinson and Davies, and by Hon. W. W. Field and Daniel S. Durrie, Esq.

Letters were read from President A. L. Chapin, of Beloit College, and Dr. I. A. Lapham, of Milwaukee, expressing their regret at not being able to attend the meeting, and uniting in the tribute of respect to their deceased associate.

On motion, a committee was appointed, consisting of Professors W. F. Allen and J. E. Davies, of the State University, and Daniel S. Durrie, Esq., Librarian to the State Historical Society, to draft resolutions expressive of the sense of the meeting.

The committee, through their chairman, reported the following resolutions, which were adopted:

Resolved, That the Academy has learned, with deep regret, of the death of its late Vice President, the Right Reverend Bishop Wm. E. Armitage, S. T. D.; and that it recognizes that in him it has lost an active and useful member, who has been identified with its interests from the beginning, and to whom a large share of its success is due.

Resolved, That these resolutions be published in each of the daily papers of this city, and that a copy of them be transmitted to the family of the deceased.

The Academy then adjourned *sine die*.

J. E. DAVIES,
General Secretary.

FOURTH ANNUAL MEETING.

First Session.

ACADEMY ROOMS, Feb. 10, 1874.

The fourth annual meeting of the Academy was commenced in these rooms on Tuesday evening, February 10, 1874, at

7½ o'clock; their being a large attendance of members and citizens; the President, Dr. J. W. Hoyt, in the chair.

The minutes of last previous meetings, regular and special, were read by the Secretary and approved.

The Librarian presented his report and tendered his resignation. Report approved; resignation subsequently withdrawn at the request of the President and many members.

The President of the Academy made appropriate and feeling remarks upon the death of the late Rt. Rev. Bishop Armitage, Vice President for the Department of the Social and Political Sciences and expressed a desire that some member of the Academy should be chosen to prepare a carefully written biographical sketch of his life and labors.

Being obliged to retire from the meeting on account of severe indisposition the President then called Dr. E. B. Wolcott, of Milwaukee to the chair, who presided during the remainder of the evening's session.

Prof. Davies next read a "Preliminary Paper on the Magnetic Rotatory Polarization of Light," illustrated by diagrams and electro-magnets.

A committee of arrangements, consisting of Professors Irving, Chamberlin and Eaton, was appoited to provide for the public evening lecture by Dr. Edmund Andrews, of Chicago, Corresponding member; also to assist in the discharge of other duties preparatory to the meeting.

On motion, the rules were suspended and the following named persons were elected annual members of the Academy to wit:

Prof. J. D. Butler, LL. D., Madison;
Prof. Edward Searing, Milton;
H. E. Copeland, Esq.;
John Bascom, President elect of the State University;
J. W. Bashford, Esq., Madison;
Thos. L. Cale, Esq., La Crosse;
W. G. Ballentine, Esq., Ripon.

Adjourned till to-morrow at 2 o'clock P. M.

Second Session.

FEBRUARY 11,—2 o'clock P. M.

The Academy met pursuant to adjournment; the President, Dr. J. W. Hoyt, in the chair.

Reading and discussion of papers resumed.

The first paper was by Rev. F. M. Holland, of Baraboo, on "Records of Marriages," after which, on motion of Prof. J. D. Butler, a committee, consisting of Dr. Hoyt and Professors Kerr and Feuling, was appointed to wait on the proper legislative

committee and to urge such changes relating to marriage certificates as are recommended in Mr. Holland's paper.

The remainder of the afternoon was occupied with the reading and discussion of the following papers:

On the Naming of America, by Prof. J. D. Butler, LL. D., Madison.
On Ranks and Classes among the Anglo Saxons, by Prof. W. F. Allen, A. M.
On the Derivation of the Word *Church*, by Prof. J. B. Feuling, Ph. D., State University.
On some Azoic Outcrops in Wisconsin not previously noticed, by Prof. T. C. Chamberlin, A. M., Beloit College.
On some Stone Implements in the Cabinet of Beloit College, by Prof. James H. Eaton, Ph. D., Beloit.

Adjourned till 7½ P. M.

Third Session.

FEBRUARY 11—7½ O'CLOCK, P. M.

Pursuant to adjournment and to published notice, the Academy met in the Assembly Chamber to receive a paper in the form of a lecture, from Dr. Edmund Andrews, A. M., M. D., of Chicago, Corresponding Member, on the views of Lyell and Lubbock on the antiquity of the human remains found near Abbeville, France; also on the age of the remains in the cave of the Fieriere, at the head of Lake Geneva, Switzerland, and on the rate of the land deposits, etc., around Lake Michigan.

The President, Dr. J. W. Hoyt, in the chair.

The paper was well illustrated with diagrams and charts, and was listened to with great attention. The authors, conclusions were, that, from all the sources examined by him, there was no sufficient ground for claiming an antiquity of more than 5,000 to 7,500 years for the oldest human remains heretofore discovered.

At the conclusion of the paper, which occupied one hour and a quarter, a vote of thanks to Dr. Andrews was moved by Dr. E. B. Wolcott, and unanimously carried; whereupon the Academy, on motion, adjourned to meet in the rooms of the Academy the following day at 2 o'clock P. M.

Fourth Session.

THURSDAY, February 12, 9 o'clock A. M.

The Academy met pursuant to adjournment.

President Hoyt in the chair.

The following papers were read by title only, to wit:

"On some peculiar Terminal Moraines," and "On the Relation of the Magnesian Limestone of Wisconsin to the Manufacture of Lime," both by Prof. T. C Chamberlin.

Prof. W. F. Allen offered the following substitute for the constitutional amendment placed on file by Prof. John E. Davies at a former meeting, to wit:

"With a view to the convenience of holding meetings, the Departments of the Academy shall be arranged in two classes, to be denominated respectively, the Class of Science and the Arts, and the Class of Philosophy and Letters, which latter shall include the Department of the Social and Political Sciences. This amendment to be an addition to section four of the constitution."

Which was laid over for one year.

The law requiring an initiation fee of $10, and an annual fee of $5, was changed so as to read, "an initiation fee of $5, and an annual fee of $2."

On motion, the transaction of further business was postponed until the evening session.

Adjourned till 2 P. M.

Fifth Session.

THURSDAY, 2 o'clock, P. M.

The Academy met pursuant to adjournment; the attendance of members and citizens being unusually large.

President Hoyt in the chair.

The following papers were read and discussed :

On the Fauna of Wisconsin—certain peculiarities thereof, by Dr. P. R. Hoy, Vice President for the Department of the Natural Sciences, read by Prof. J. D. Butler.
History of the Science of Hydraulics, by Col. W. J. L. Nicodemus, Professor in the University of Wisconsin.
On the Influence of Duties on Imports on the Value of Gold, by John Y. Smith, Esq., Madison.
On the strength of Materials, by John Nader, U. S. Asst. Engineer.

The Academy adjourned till 7½ o'clock.

Sixth Session.

THURSDAY, 7½ P. M.

The Academy met pursuant to adjournment, with a full attendance.

The President in the chair.

Papers were read as follows:

On the Philosophy of Evolution, by Prof. S. H. Carpenter, State University; and
On the Amount of Arsenic absorbed by the Human Liver, by Prof. W. W. Daniells, State University.

Remarks on the latter paper were made by Drs. Joseph Hobbins and E. B. Wolcott; after which, on motion, the Academy *went into* a business session.

Dr. Wolcott reported favorably on the nomination of Dr. Ely Van De Warker, of Syracuse, N. Y., who was thereupon elected a Corresponding Member.

The following persons were also nominated for corresponding membership, and elected under a suspension of the rules:

Lewis H. Morgan, LL.D., Rochester, N. Y.
T. W. Harris, LL.D., St. Louis, Mo.;
Herbert P. Hubbell, Esq., Winona, Minn.;
John A. McAllister, Esq., Philadelphia, Pa.

Prof. O. M. Conover, Madison, and Prof. Thure Kumlein, of Albion College, were elected Annual Members.

The Treasurer of the Academy presented his annual report, as follows:

WISCONSIN ACADEMY OF SCIENCES, ARTS AND LETTERS,
Office of the Treasurer,
MADISON, February 10, 1874.

Hon. J. W. HOYT, *President:*

SIR: I have the honor to report the financial condition of the Academy as follows:

Total amount of fees and dues received from 51 members	$592 25
Fees received from 10 Life members	1,000 00
Interest on loan of same	100 00
	$1,692 25
Amount disbursed in payment of warrants to date	555 55
Balance in treasury	$1,136 70
Placed to credit of Life Members' Fund	$1,000 00
Placed to credit of General Fund	136 70

G. P. DELAPLAINE, *Treasurer.*

The report was read and referred to a committee consisting of members Nicodemus, Wolcott and Durrie, who, after a careful examination, reported the same back with an endorsement of its correctness.

Prof. Daniells called up his amendment to the constitution, providing that hereafter the election of officers shall be by ballot, which was adopted, *nem con.*

On motion, a committee consisting of Dr. J. W. Hoyt, Dr. E. B. Wolcott, Ex-Gov. Nelson Dewey, and Rev. J. W. Bashford, was appointed to procure the printing of the Academy's Transactions.

President Hoyt submitted a proposition that the constitution be so amended as to make the President and Secretary of the Wisconsin State Horticultural Society members *ex-officio* of the General Council of the Academy; also the following motion:

That the Treasurer be instructed to omit the collection of further dues from the Secretary of the State Historical Society.

The proposition was put on file and the motion was adopted.

Secretary Davies offered the following, which was unanimously adopted:

Resolved, That the President is hereby requested to designate some member of the Academy to prepare a suitable sketch of the life and labors of the late Rt. Rev. Bishop Armitage, Vice President for the Department of the Social and Political Sciences, for publication in the next volume of Transactions.

On motion, a ballot was taken for a Vice President of the Department of the Social and Political Sciences, to fill the vacancy caused by the death of Bishop Armitage, which resulted in the election of Rev. Dr. G. M. Steele, D. D., President of Lawrence University, Appleton.

Dr. E. B. Wolcott, of Milwaukee, was chosen to succeed Dr. Steele as Counselor for said Department.

In pursuance of a proposition submitted at the third annual meeting, there was created the new Department of Speculative Philosophy; and on motion a ballot was taken for the two principal officers thereof, with the follow result:

Vice President—Prof. S. H. Carpenter, LL.D., State University.
Secretary—Rev. F. M. Holland, Baraboo.

The following resolutions were adopted:

Resolved, That hereafter there shall be held a meeting of one or more departments of Academy on the second Tuesday of each month.

Resolved, That the next regular meeting of the Academy be held in the city of Milwaukee on the 1st Tuesday in July.

The President and Secretary to have authority to change time and place if it shall be best to do so.

Resolved, That the thanks of the Academy are hereby tendered to the Assembly for the use of their chamber for the Wednesday evening's session, and to the Madison *Democrat* and the *State Journal* for their valuable reports of the proceedings of the Academy.

The President designated the Rev. J. B. Pradt as the member who should prepare a biographical notice of the lamented Bishop Armitage, [which notice will be found on the following page.]

The Academy adjourned *sine die*.

JOHN E. DAVIES,
General Secretary.

IN MEMORIAM.

BY REV. J. B. PRADT, MADISON.

Entered into rest, December 7, 1873, the Rt. Rev. WILLIAM EDMOND ARMITAGE, S. T. D., Bishop of Wisconsin, and Vice President of this Academy.

William Edmond Armitage was born in the city of New York, September 6, 1830. Educated under the influences of the Episcopal Church, he entered Columbia College, in the same city, at the earliest age the statutes of that institution allowed, and graduated with honor in 1849, at the age of 19.

Having, from early youth, determined to devote himself to the sacred ministry, after graduation he immediately entered the General Theological Seminary of the Episcopal Church, in New York, and after finishing the usual three years' course of study, was ordained deacon early in the summer of 1852, and to the priesthood in 1854.

His first ministry was as assistant to the venerable Dr. Burroughs, rector of St. John's Church, Portsmouth, N. H. His first parish was St. Mark's Church, Augusta, Me., where, in 1858, he married Louisa, daughter of Mr. Allan Lombard.

His next parish was St. John's Church, in the city of Detroit, of which he was the first rector, and which he built up to a very remarkable degree of strength and prosperity.

From this post of usefulness he was called, in 1866, to become the Assistant of the venerable Bishop Kemper, of Wisconsin, his consecration taking place in his own parish church, December 6, and his funeral in the same church seven years later, December 11.

It is in keeping with the beautiful symmetry of his character, that he thus spent seven years in scholarly preparation for his life-work, seven years in its more youthful prosecution at the east, seven more of matured labor at the west, and seven as a Christian Bishop in Wisconsin. For Dr. Armitage was indeed a man of singularly beautiful and symmetrical life and character. Of sweet and serene temper, of methodical habits, of orderly and untiring industry and devotion, these traits ex-

tended to every part of his life, and gave character to his thought, his speech, his chirography and to his manners.

As might be expected from such a man, his mind was singularly free from dogmatism and illiberality, While firm in his own convictions, he was courteous and charitable towards those who thought differently. In this respect he was a model as a man as well as an ecclesiastic. Nor was he so absorbed in his peculiar calling as to disregard or underrate secular things. On the contrary, he took a lively interest in the promotion, not only of the arts and sciences, but of the general business of life.

In the department of the Academy entrusted to his charge as a Vice President, namely, that of Social Science, he took especial interest, and was anxious that its management and labors might be attended with beneficent results. He made, himself, a valuable contribution to the labors of the Academy in this department, in a paper on the Sunday Question.* In the discussion of this delicate subject he showed himself equally free from bigotry and weakness.

Though much pressed with the burden of his Episcopal duties, and suffering from a disease which shortened his life, he found time to attend several meetings of the Academy, and evinced, by frequent letters, his interest in its affairs.

His memory will be cherished by his associates in the Academy with respectful and affectionate regret, and his character revered, not only for its higher qualities, but as one eminently befitting all who would promote the cause of truth, of science and of human progress.

* Published in Vol. I of the Transactions, page 62.

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